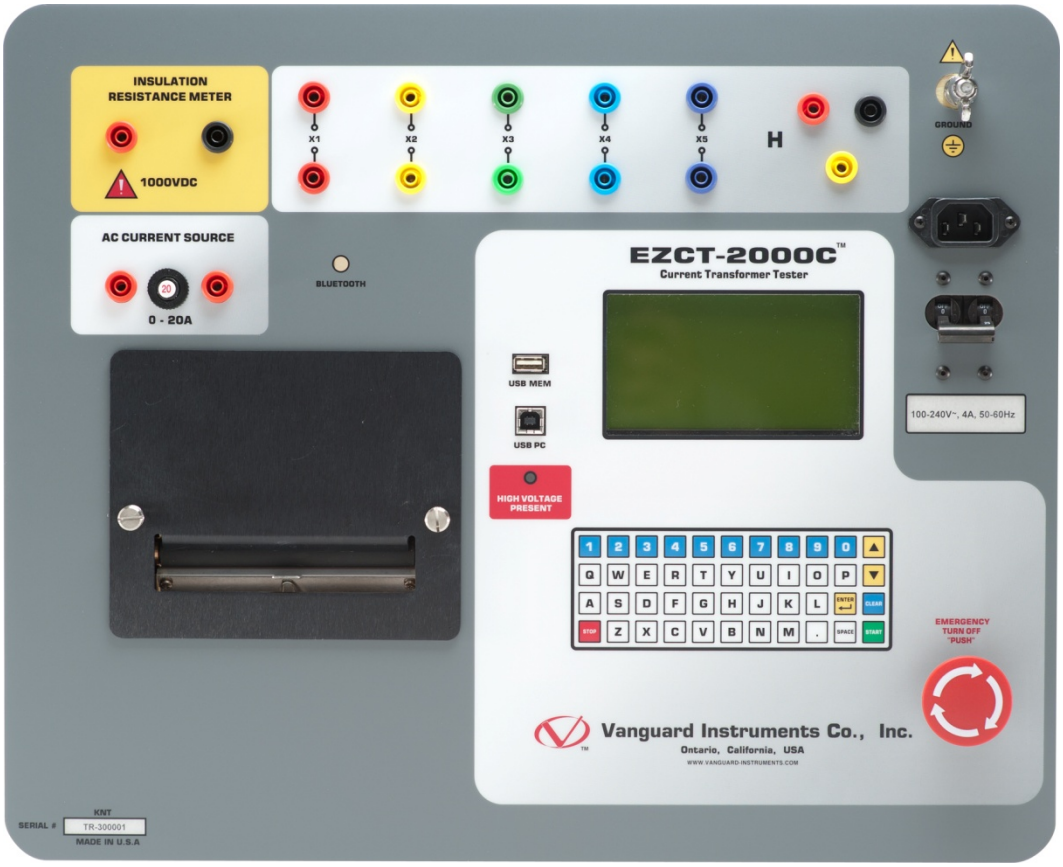
EZCT-2000C™

DIGITAL CURRENT-TRANSFORMER TESTER

USER'S MANUAL



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SAFETY SUMMARY

FOLLOW EXACT OPERATING PROCEDURES

Any deviation from the procedures described in this User's Manual may create one or more safety hazards, may damage the EZCT-2000C, or cause errors in the test results. Vanguard Instruments Company, Inc. assumes no liability for unsafe or improper use of the EZCT-2000C.

All safety precautions provided in this manual must be observed during all phases of testing including test preparation, test lead connection, actual testing, and test lead disconnection.

SAFETY WARNINGS AND CAUTIONS

The EZCT-2000C can produce a voltage up to 2,000 Vac that can cause severe injury and/or equipment damage. Due to this reason, the EZCT-2000C shall be used only by **trained operators**.

The EZCT-2000C's X output terminals are rated to 2,200 Vac working voltage. Any voltage above 2,200 Vac will damage the input circuitry. Please see section 3.2 for further information.

All devices under test shall be **off-line** and **fully isolated**. Never attempt to test any current transformer still connected to a circuit. All current transformer terminals shall be isolated before conducting any test with the EZCT-2000C.

Always ground the EZCT-2000C to a substation ground before connecting the test cables to a transformer.

DO NOT MODIFY TEST EQUIPMENT

To avoid the risk of introducing additional or unknown hazards, do not install substitute parts or perform any unauthorized modification to any EZCT-2000C test unit. To ensure that all designed safety features are maintained, it is highly recommended that repairs be performed only by Vanguard Instruments Company factory personnel or by an authorized repair service provider. Unauthorized modifications can cause safety hazards and will void the manufacturer's warranty.

WARNING

Do not remove test leads during a test. Failure to heed this warning can result in electrical shock to personnel and damage to the equipment.

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CONVENTIONS USED IN THIS DOCUMENT

This document uses the following conventions:

- A key or switch on the EZCT-2000C is indicated as **[KEY]**.
- Menu options are referenced as (*MENU OPTION*).
- Screen and menu names are referenced as "SCREEN/MENU NAME".
- The terms "test record" and "test shot" are used interchangeably.
- The terms "USB Flash drive" and "USB thumb drive" are used interchangeably.
- EZCT-2000C LCD screen output is shown as:

```
1. OPTION 1
2. OPTION 2
3. OPTION 3
4. OPTION 4
5. OPTION 5
```

- Warning messages are indicated as:

Warning message

WARNING

- Important notes are indicated as:

Note details

NOTE

1.0 INTRODUCTION

1.1 General Description and Features

The EZCT-2000C is Vanguard's third-generation microprocessor-based current transformer test set. The EZCT-2000C is available in two models, the EZCT-2000C and EZCT-2000C Plus. Designed specifically for CT testing, the EZCT-2000C has the following outstanding features that can greatly increase productivity and save time during the commissioning stage:

- Performs CT excitation, current-ratio, polarity, and phase angle tests
- Automatically demagnetize CT under test when performing excitation tests
- Measure the DC resistance of transformer windings from 100 micro-ohms to 20 ohms
- Stand-alone or computer-controlled via USB or optional Bluetooth wireless interface

In addition to the above, the EZCT-2000C Plus offers the following features:

- Measures the insulation resistance of the CT's secondary winding
- Measures the CT's load burden
- Provides a programmable current source (0-20A) that can be used to verify CT loads

The EZCT-2000C's test leads can be connected to all the CT output terminals, and the complete CT test can be performed automatically without any operator intervention.

1.2 Common Features (EZCT-2000C and EZCT-2000C Plus)

Excitation Test

The CT excitation test is performed using the ANSI/IEEE C57.13.1 test method. Test voltage ranges from 50, 300, 500,1200 and 2000 Vac can be selected for the excitation test. The test voltage is raised and lowered automatically by the EZCT-2000C. The excitation test voltage and current data is collected and stored in the EZCT-2000C's internal memory. Knee point voltages (ANSI 10/50, IEC 60044, IEEE-30, IEEE-45) are calculated and printed on the test report. All of the EZCT-2000C's test leads can be connected to the CT output terminals (X1, X2, X3, X4 and X5), and there is no lead switching required during testing. This convenient arrangement allows for testing any of the 10 possible combinations of X1 to X5. Up to 10 excitation tests can be stored in one record. Once the test is completed, the test report and CT excitation curves can be printed on the built-in thermal printer.

Demagnetization

The EZCT-2000C automatically demagnetizes the CT under test when performing an excitation test.

Winding Resistance Test

The EZCT-2000C can measure the DC resistance of transformer windings from 100 micro-ohms to 10 ohms.

Ratio and Polarity Tests

The CT current-ratio is determined using the ANSI/IEEE C57.12.90 measurement method. A test voltage is applied on any two terminals (X1 to X5) of the CT, and the induced voltage is measured through the H1 and H2 terminals of the CT. The CT current-ratio is displayed and also stored in memory. The current-ratio is measured from 0.8 to 5,000. The CT winding polarity is

displayed as a "+" sign (in-phase) or a "-" sign (out-of-phase) and is annotated with the phase angle in degrees. The CT current ratio error and phase displacement is also calculated based on the CT burden (or rated power) and rated current.

Current Ratio and Phase Error Tables

As part of the tabulated test results, the EZCT-2000C can also print the current ratio and current phase error tables.

Test Record Header Information

Test record header information, including the company, substation name, circuit ID, manufacturer, mode, CT serial number, and the operator's name, can be stored with each record. In addition to the test record header, a 20-character test description for each test in the record (10 tests per record) can also be entered.

User Interface and Display

The EZCT-2000C features a back-lit LCD screen (240 x 128 pixels) that is clearly viewable in both bright sunlight and low-light levels. An "QWERTY"-style membrane keypad is used to enter test information and to control the unit's functions.

Built-in Thermal Printer

A 4.5-inch wide built-in thermal printer can print the CT test results and excitation curves.

Computer Interface

The EZCT-2000C can be used as a stand-alone unit or can be computer-controlled. It can be connected to a PC via the USB port or wirelessly via Bluetooth. In computer-controlled mode, using the included CT Analysis Software, test records can be downloaded from the EZCT-2000C's memory, or CT tests can be run from the PC. Test plans can also be created with the provided software. A test plan defines the various test parameters (test voltage, current range, nameplate ratios, etc.) and can be used to quickly perform tests. Additionally, tabulated test records are automatically exported to PDF, Excel, and XML formats for further analysis.

Internal Test Record Storage

The EZCT-2000C can store up to 140 test records in Flash EEPROM. Each record may contain up to 10 excitation curves, burden test reports, current ratio readings, and polarity and DC resistance readings. Test records can be recalled and printed on the built-in thermal printer. They can also be transferred to a PC using the USB port, wirelessly via Bluetooth, or via the USB Flash drive interface port.

Internal Test Plan Storage

The EZCT-2000C can store up to 128 CT test plans in Flash EEPROM. A test plan is comprised of the excitation test voltage, current range selection, CT nameplate ratios, and CT winding terminal combinations (X1 to X5) for each test and also includes the insulation test definition. Up to 10 test definitions can be stored per test plan. The ability to store test plans makes CT testing an extremely simple process. To perform a test, the EZCT-2000C is connected to the CT terminals and a test plan is selected to run.

Creating test plans for the EZCT-2000C is also a simple process. A test plan can be created using the EZCT-2000C's keypad or can be created on a PC (with provided software) and then downloaded to the EZCT-2000C via the USB port or Bluetooth. For added convenience, test plans can also be copied from a USB Flash drive to the EZCT-2000C via the USB Flash drive interface.

External Data Storage

The EZCT-2000C features a USB Flash drive interface that makes it very convenient to store and transfer test records and test plans. By using a USB Flash drive, test records and test plans can be quickly transferred between a computer and the EZCT-2000C without the need to connect the unit to the computer.

1.3 EZCT-2000C Plus Features

CT Winding Insulation Resistance Test Feature

The EZCT-2000C Plus can also measure the insulation resistance of the CT's secondary winding using a test voltage up to 1000 Vdc. The DC winding resistance reading range is from 2 to 500 Mega-ohms. The insulation resistance test results are displayed and printed on the report.

CT Burden Test

The EZCT-2000C Plus can measure the CT's actual connected burden by injecting a 1A or 5A test current into the load. The CT burden measurements (Voltage, current, Cos φ, and burden impedance) are displayed on the screen and printed on the test report. This important test verifies the actual CT measured burden before putting the CT in service, thus avoiding any potential configuration conflicts.

Current Source

The EZCT-2000C Plus offers an optional programmable current source (0-20A, 0-15Vac) that can be used to verify CT loads. The on-time timer and output current are displayed on the LCD screen.

1.4 Ordering Information

To order additional EZCT-2000C units or accessories, please contact your Vanguard Instruments sales representative and reference the part numbers listed in Table 1. Please visit our web site at http://www.vanguard-instruments.com/sales-reps to find your nearest Vanguard Instruments sales representative.

Table 1. Ordering Information

Part Number	Description
9019-UC	EZCT-2000C [110V] Unit and Cables
9034-UC	EZCT-2000C [220V] Unit and Cables
9019-SC	EZCT-2000C Shipping Case
9019-IC	EZCT-2000C Insulation Resistance Test and Current Source Feature
8000-0157	Replacement H cable set with banana jacks
8000-0108	Replacement X cable set
8000-0109	Replacement current and Megger cable set
8000-0005	USB cable
8000-0017	Large cable carrying duffel bag
TP4-CS	TP4 thermal printer paper (case of 24 rolls)

1.5 Technical Specifications

Table 2. EZCT-2000C Technical Specifications

TYPE	Portable current-transformer test set
PHYSICAL SPECIFICATIONS	19"W x 13"H x 16"D (48.3 cm x 33cm x 40.1 cm); Weight: 73 lbs (33.1 kg)
INPUT POWER	100 – 120 Vac or 200 – 240 Vac (factory pre-set), 50/60 Hz
MEASUREMENT METHOD	ANSI/IEEE C57.12.90 and ANSI/IEEE C57.13.1 standards
OUTPUT TEST VOLTAGES	0 – 50 Vac @ 10A max; 0 – 300 Vac @ 10A max; 0 – 500 Vac @ 5A max; 0 – 1200 Vac @ 1.2A max; 0 – 2000 Vac @ 1A max
CURRENT SOURCE (EZCT-2000C Plus Only)	1 – 20A @ 0 – 15 Vac
CURRENT SOURCE DISPLAY (EZCT-2000C Plus Only)	Test current and current on-time
VOLTAGE READING RANGE	0 – 2,200 Vac; Accuracy: ±1.0% of reading, ±1 volt
CURRENT READING RANGE	0 – 10A; Accuracy: ±1.0% of reading, ±0.02A
CT CURRENT RATIO RANGE	0.8 – 999: 0.1%, 1000 – 1999: 0.3%, 2000 – 5000: 1%
PHASE ANGLE MEASUREMENT	0 – 360 degrees; Accuracy: ± 1.0 degree)
RESISTANCE READING RANGE	100 micro-ohms – 10 ohms; Accuracy: 2% of reading, ±1 count, ±10 micro-ohms
INSULATION RESISTANCE TEST FEATURE (EZCT-2000C Plus Only)	2 Mega-ohms – 500 Mega-ohms; Accuracy: 3% of reading, 500 – 1000 Vdc test voltage
DISPLAY	Backlit LCD Screen (240 x 128 pixels; 114mm x 64mm); viewable in bright sunlight and low-light levels
PRINTER	Built-in 4.5-inch wide thermal printer
COMPUTER INTERFACES	One USB port and Bluetooth wireless intaerface
EXTERNAL DATA STORAGE	One USB Flash drive interface port (Flash drive not included)
PC SOFTWARE	Windows®-based CT Analysis software is included with purchase price
INTERNAL TEST RECORD STORAGE	Stores 140 test records. Each test record may contain up to 10 sets of excitation, resistance and ratio data
INTERNAL TEST PLAN STORAGE	Stores 128 test plans. Each test plan can store 10 excitation test voltage and current settings
SAFETY	Designed to meet UL 6110A-1 and CAN/CSA C22.2 No. 1010.1-92 standards
ENVIRONMENT	Operating: -10°C to 50°C (15°F to +122°F); Storage: -30°C to 70°C (-22°F to +158°F)
CABLES	One 20-foot cable set (X1-X5), one 35-foot H cable set, current source cables, insulation test cables, power cord, ground cable. A transportation case is included with the purchase price
WARRANTY	One year on parts and labor

NOTE

The above specifications are valid at nominal operating voltage and at a temperature of 25°C (77°F). Specifications may change without prior notice.

1.6 EZCT-2000C Controls and Indicators

The EZCT-2000C's controls and indicators are shown in Figure 1 below. A leader line with an index number points to each control and indicator, which is cross-referenced to a functional description in Table 3. The table describes the function of each item on the control panel. The purpose of the controls and indicators may seem obvious, but users should become familiar with them before using the EZCT-2000C. Accidental misuse of the controls will usually cause no serious harm. Users should also be familiar with the safety summary found on the front page of this User's Manual.

Figure 1. EZCT-2000C Controls and Indicators

Table 3. Functional Descriptions of EZCT-2000C Controls and Indicators

Item Number	Panel Markings	Functional Description
1	INSULATION RESISTANCE METER	Insulation resistance meter connectors.
2-6	X1, X2, X3, X4, X5	Current transformer excitation voltage connectors. Each set of connectors contains a test voltage connector and sensing connector. The EZCT-2000C's X output terminals are rated to 2,200 Vac working voltage. **Any voltage above 2,200 Vac will damage the input circuitry**.
7	H	Current transformer primary input test cable connectors.
8	GROUND	Grounding stud.
9		AC receptacle.
10	100-120Vac, 12A 50-60Hz	Power switch with built-in circuit breaker.
11		Back-lit graphic LCD screen (128 x 64); viewable in bright sunlight and low light levels.
12	HIGH VOLTAGE PRESENT	LED warning indicator that is illuminated when high voltage is present.
13		Rugged, "QWERTY"-style membrane keypad
14	EMERGENCY TURN OFF "PUSH"	Emergency turn off switch.
15		Built-in 4.5-inch wide thermal printer
16	USB PC	USB PC interface.
17	USB MEM	USB Flash drive interface
18	AC CURRENT SOURCE 0 – 20A	AC current source connectors (EZCT-2000C Plus Only)
19	BLUETOOTH	Bluetooth indicator (Optional)

2.0 PRE-TEST SETUP

2.1 Operating Voltages

The EZCT-2000C's operating voltage is preset at the factory for 100-120 Vac, 50/60 Hz or 200-240 Vac, 50/60 Hz.

2.2 LCD Screen Contrast Control

To increase the LCD screen contrast, press and hold the **[∧]** key for two seconds. Release the button when the desired contrast level has been reached.

To decrease the LCD screen contrast, press and hold the **[∨]** key for two seconds. Release the button when the desired contrast level has been reached.

2.3 Printer Paper Control

To advance the thermal printer paper, press and release the **[∧]** key.

To retract the thermal printer paper, press and release the **[∨]** key.

2.4 Printer Paper

The EZCT-2000C's built-in thermal printer uses 4.5-inch wide thermal paper for printing test results. To maintain the highest print quality and to avoid paper jams, the use of thermal paper supplied by Vanguard Instruments Company is highly recommended. Additional paper can be ordered from the following sources:

Vanguard Instruments Co, Inc.
1520 S. Hellman Avenue
Ontario, CA 91761
Tel: 909-923-9390
Fax: 909-923-9391
Part Number: TP4-CS (24 rolls) or TP4-3R (3 rolls)

BG Instrument Co.
13607 E. Trent Avenue
Spokane, WA 99216
Tel: 509-893-9881
Fax: 509-893-9803
Part Number: VIC TP-4 paper

2.5 Replacing the Thermal Printer Paper

The roll of thermal paper is housed inside a dispenser underneath the printer cover. To replace the paper, follow the steps below:

- Unscrew the two large printer cover screws and remove the printer cover.
- Remove the leftover thermal paper roll from the paper holder.
- Unroll the new thermal paper roll.
- Feed the thermal paper into the slot between the paper pocket and the rubber roller. The printer will automatically pull the paper under the thermal head.
- Place the paper roll into the paper holder.
- Lift the thermal head and align the thermal paper if necessary.
- Re-install the printer cover.

NOTE

Thermal paper has a chemical coating on one side of the paper. This side should be facing the thermal print head. Incorrect paper loading may result in blank output on the thermal paper.

The thermal paper will show a red stripe to indicate that the roll is about to run out of paper.

3.0 OPERATING PROCEDURES

3.1 EZCT-2000C Cable Connections

Always connect the EZCT-2000C to the substation ground before connecting any test cables. The EZCT-2000C is supplied with five 20-foot X test cables and one 35-foot H cable. The X cable connections are required to run the current transformer excitation test. The H and X cable connections are required to run the transformer turns-ratio test. A typical excitation and ratio test connection is shown in Figure 2. The insulation resistance test connection is shown in Figure 3. The burden test connection is shown in Figure 6. The current source test connection is shown in Figure 7. Transformer bushing CT connections for Delta and Y transformers are shown in Figure 8 and Figure 9, respectively.

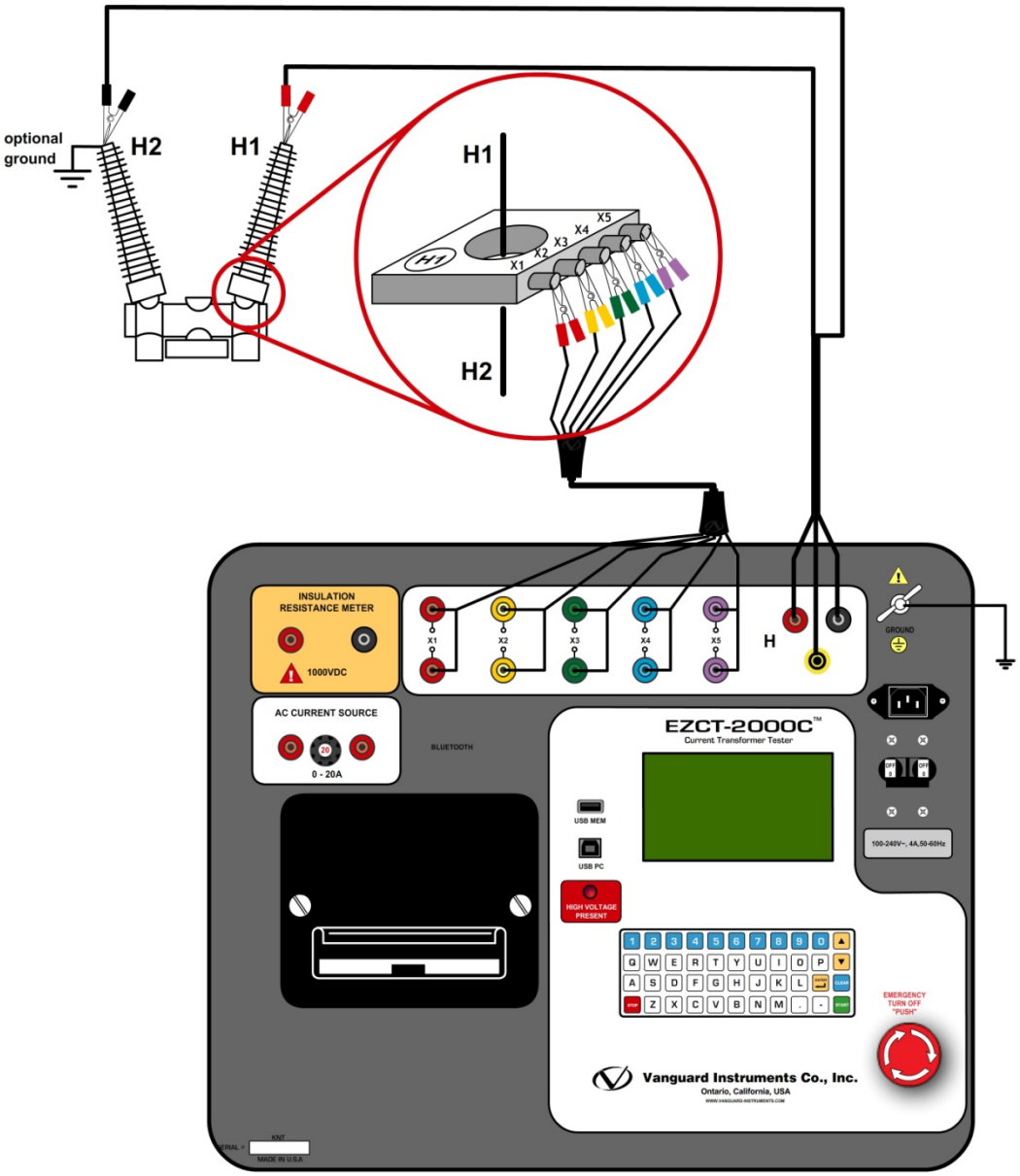


Figure 2. Typical EZCT-2000C Excitation and Ratio Test Cable Connections

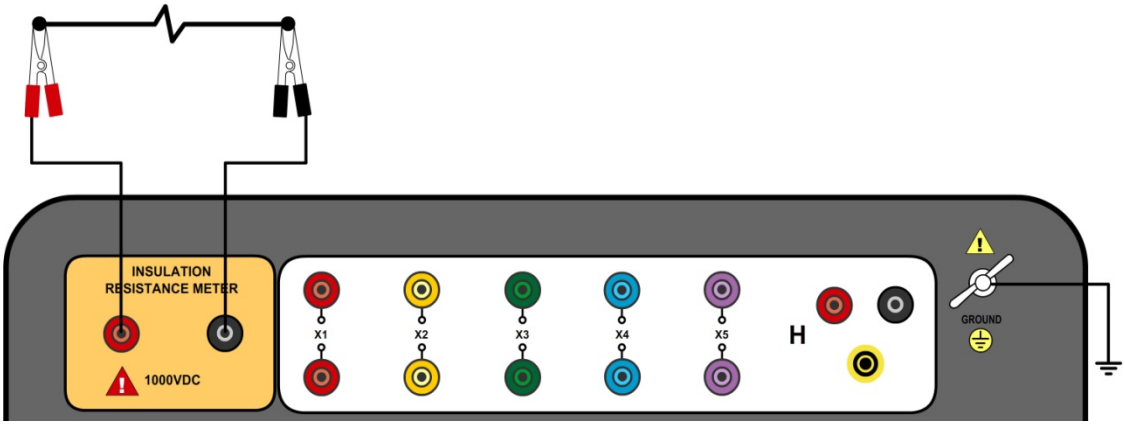


Figure 3. Connections for a typical high resistance measuring application

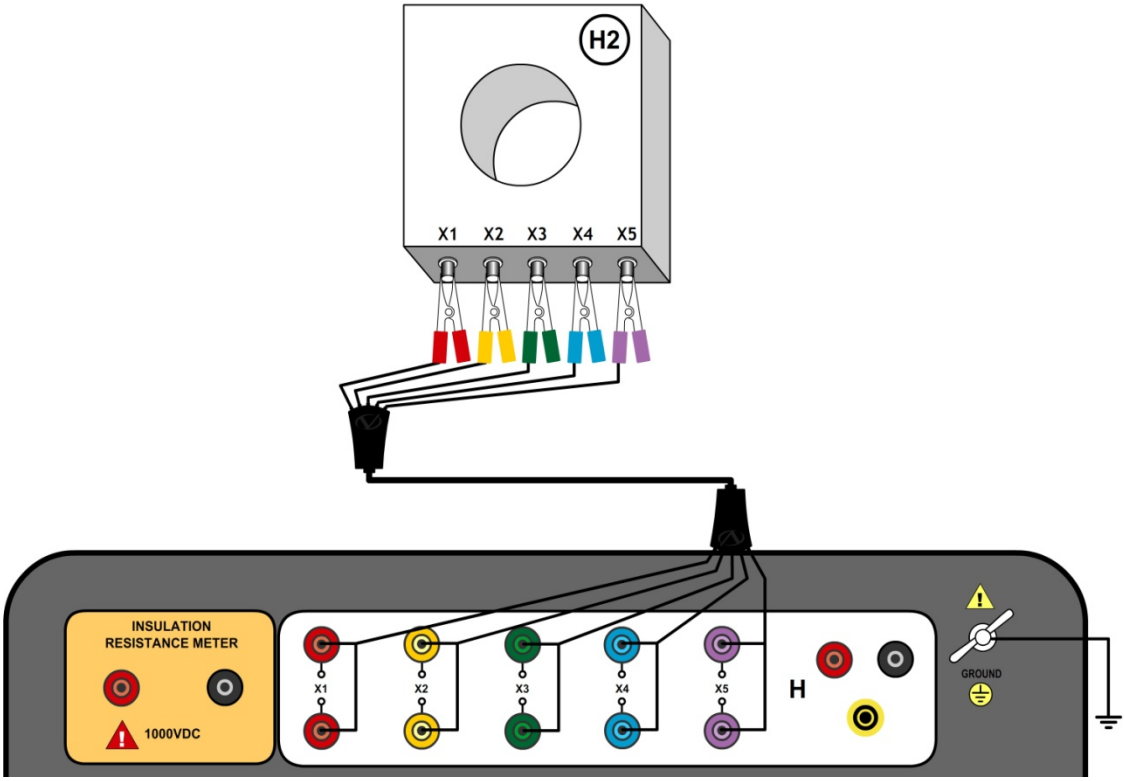


Figure 4. Connections for a typical insulation resistance measurement for a CT with 5 terminals

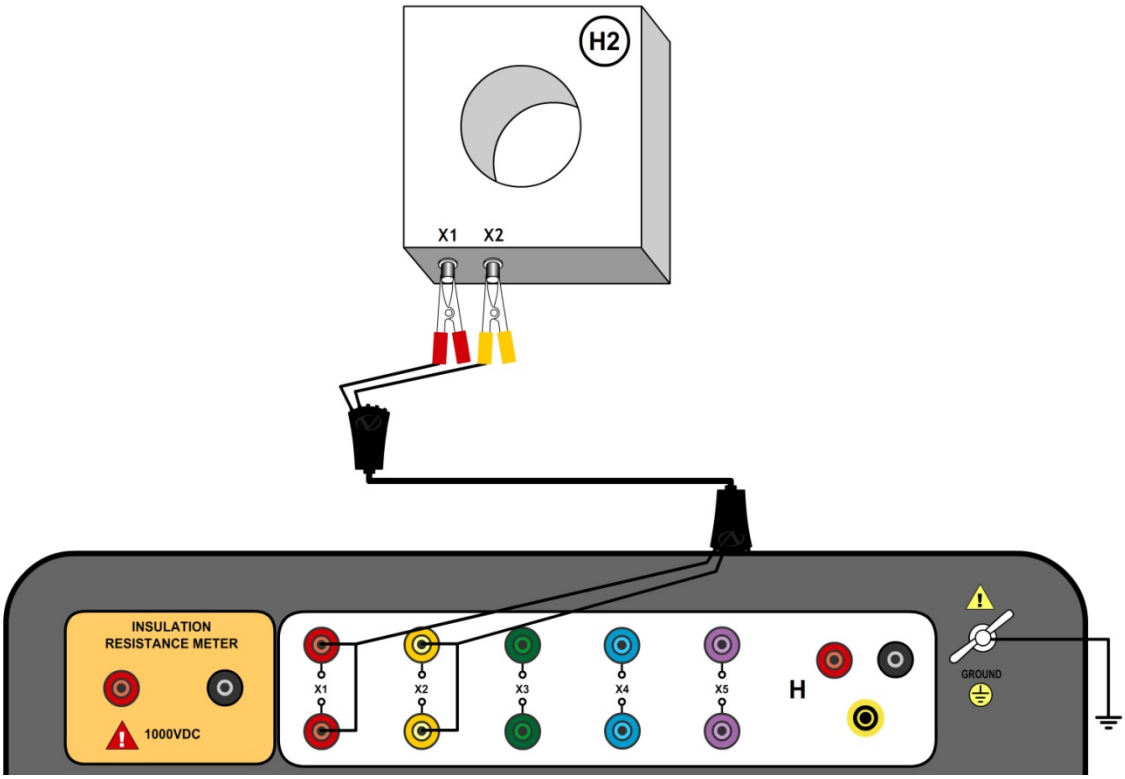


Figure 5. Connections for a typical insulation resistance measurement for a CT with 2 terminals

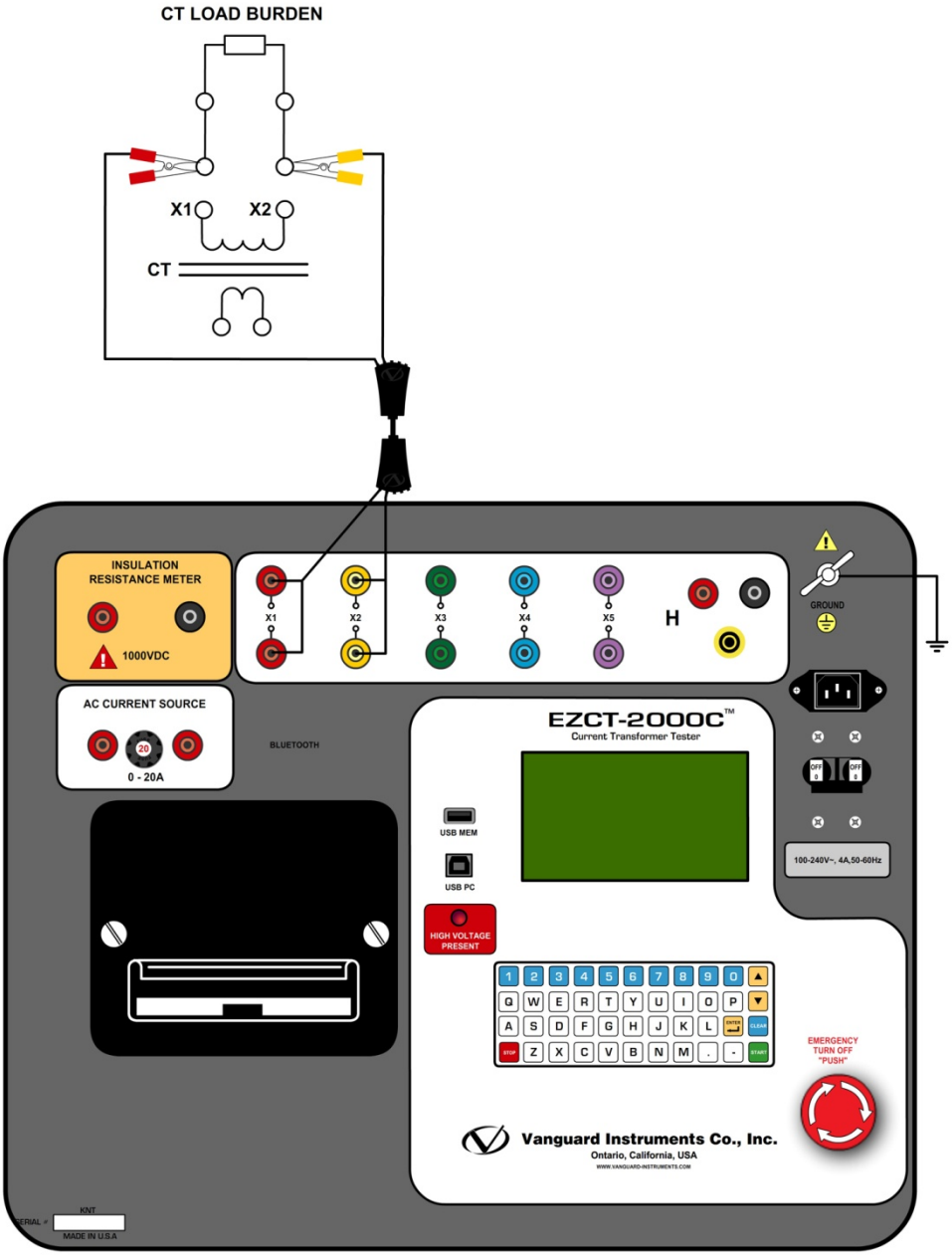


Figure 6. EZCT-2000C CT Burden Test Cable Connection (EZCT-2000C Plus Only)

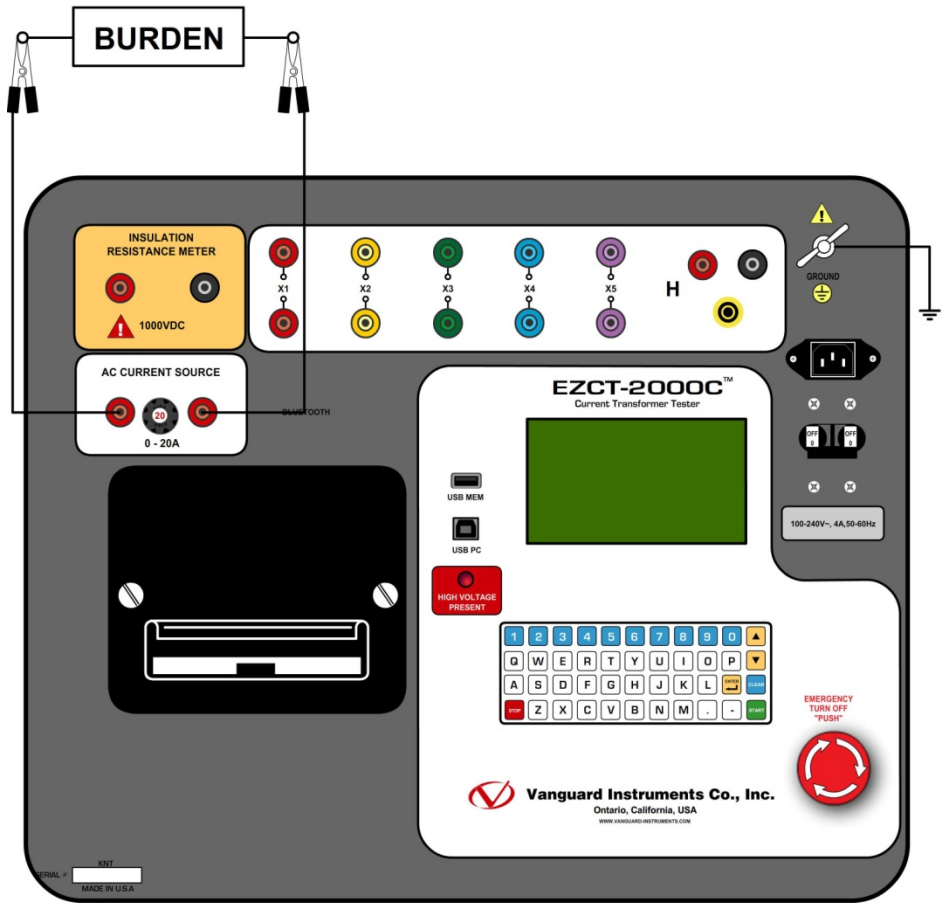


Figure 7. EZCT-2000C Typical Current Source Connection (EZCT-2000C Plus Only)

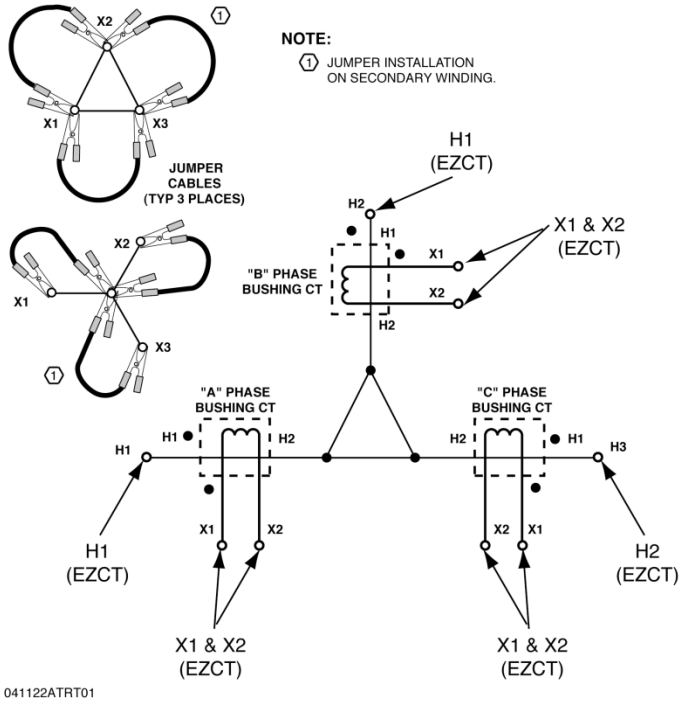


Figure 8. Bushing CT Connection on Delta Transformer

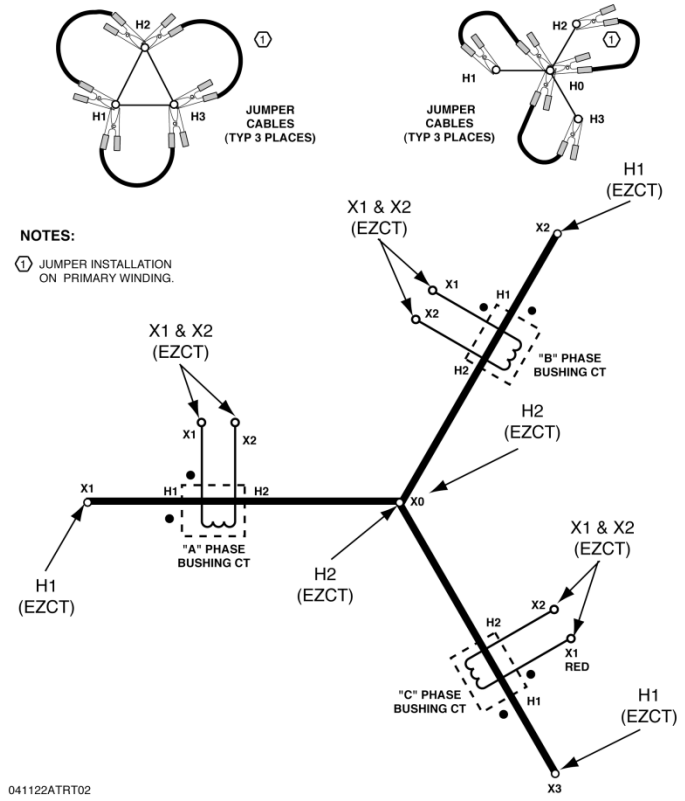


Figure 9. Bushing CT Connection on Y Transformer

3.2 EZCT-2000C X Input Voltage Warning

The EZCT-2000C X output terminals are rated to 2,200 Vac working voltage. Any voltage present at these terminals above 2,200 Vac may damage the X sense circuitry, cause false readings, or both. An example of a typical situation where this may occur is shown in Figure 10 below.

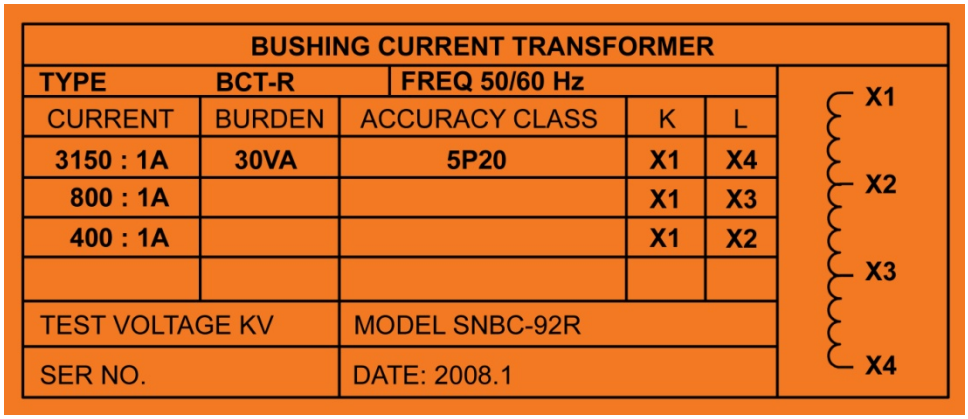


Figure 10. Sample CT Name Plate

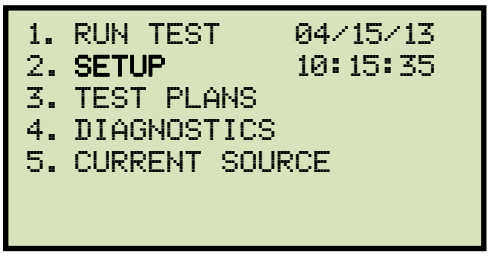
For the above example CT, the turns ratio between X1-X4 is 3150 to 1. The turns ratio between X1-X2 is 400 to 1. The turns ratio between X1-X4 and X1-X2 is 7.88 (3150/400). If a test voltage of 300 Vac is applied to the X1-X2 terminals, a voltage of 2,364 Vac (300 Vac x 7.88) will be induced at the X1-X4 terminals. If all the test leads are connected to the EZCT-2000C and the excitation test is performed on the X1-X2 terminals, the voltage induced at the X1-X4 terminals will exceed 2,000 Vac as the voltage across the X1-X2 terminals increases above 250 Vac. A "Flash-Over" condition may occur and damage the EZCT-2000C. In this case, the user should only connect the X1-X2 leads and run its excitation test, then connect the X4 lead before running the X1-X4 excitation test.

3.3 Performing Tests

3.3.1. Entering Test Record Header Information

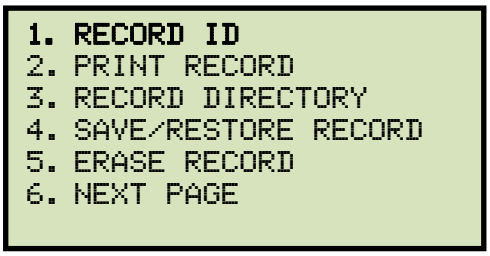
You can enter the test record header information before performing tests. The record header includes identifying information such as the company, station, circuit, model number, etc. Once the header information has been entered, it will apply to all subsequent test records. To enter the header information:

a. When the unit is turned on and the firmware has been loaded, you will be presented with the "START-UP" menu as shown below:



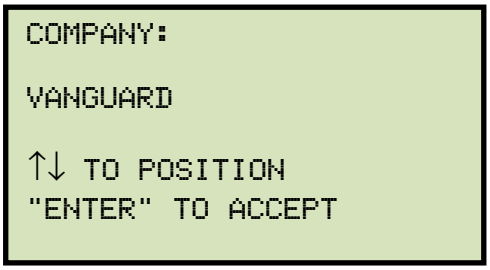
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



Press the **[1]** key (*RECORD ID*)

c. The following screen will be displayed:



Type the company name using the keypad and then press the **[ENTER]** key.

d. The following screen will be displayed:

```
STATION:

LAB

↑↓ TO POSITION
"ENTER" TO ACCEPT
```

Type the station name using the keypad and then press the **[ENTER]** key.

e. The following screen will be displayed:

```
CIRCUIT:

CIRCUIT 1

↑↓ TO POSITION
"ENTER" TO ACCEPT
```

Type the circuit information using the keypad and then press the **[ENTER]** key.

f. The following screen will be displayed:

```
MANUFACTURER:

ABB

↑↓ TO POSITION
"ENTER" TO ACCEPT
```

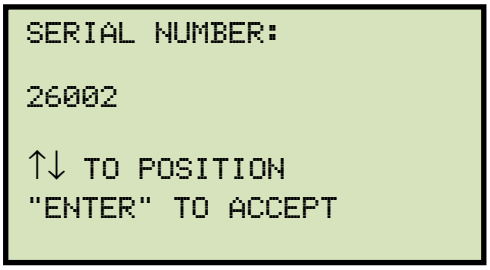
Type the manufacturer name using the keypad and then press the **[ENTER]** key.

g. The following screen will be displayed:

```
MODEL:

EZCT2000C

↑↓ TO POSITION
"ENTER" TO ACCEPT
```

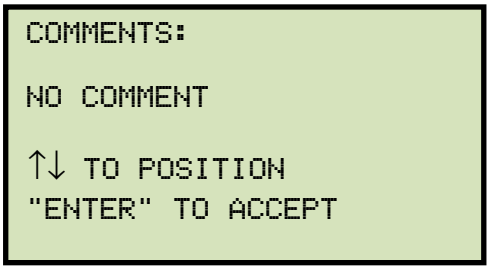
Type the model information using the keypad and then press the **[ENTER]** key.

h. The following screen will be displayed:



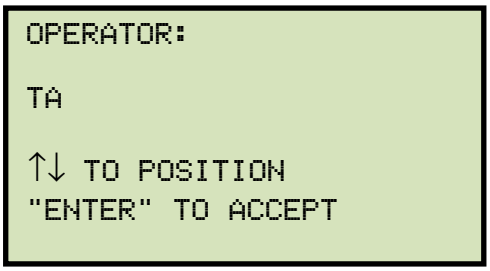
Type the serial number using the keypad and then press the **[ENTER]** key.

i. The following screen will be displayed:



Enter any relevant comments using the keypad and then press the **[ENTER]** key.

j. The following screen will be displayed:

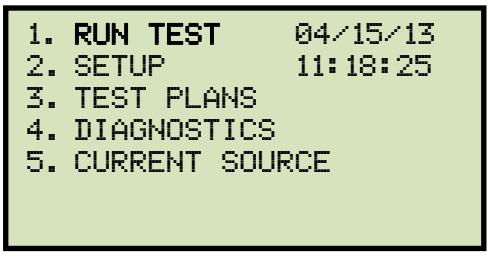


Type the operator's name using the keypad and then press the **[ENTER]** key. All header information will be saved, and you will be returned to the "START-UP" menu.

3.3.2. Performing Resistance, Excitation, and Ratio Tests

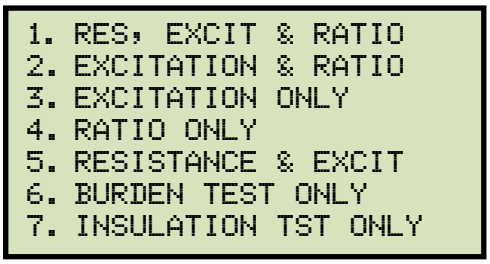
The following procedure describes the general steps for performing excitation, resistance, and ratio tests.

a. When the EZCT-2000C is turned on, it will first go through a start-up cycle and load the firmware. Then the "START-UP" menu will be displayed as shown below:



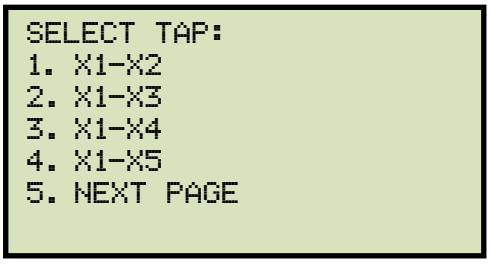
Press the **[1]** key (*RUN TEST*) to start a test.

b. The following screen will be displayed:



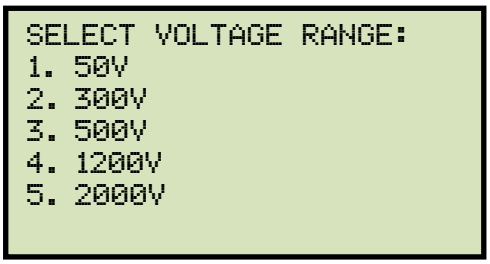
Select the test type by pressing the corresponding key **([1]** - **[5])**

c. The following screen will be displayed:



Select the tap connection by pressing the corresponding key **([1]** - **[4])**. If the tap connection is not listed, press the **[5]** key to view the next page of options.

d. If the selected test included an excitation test, the following screen will be displayed:



Select a test voltage range by pressing the corresponding key (**[1]** - **[5]**).

e. If the selected test included an excitation test, the following screen will be displayed:

```
SET TEST CURRENT:
1. 0.2A
2. 0.5A
3. 1A
4. 2A
5. 5A
6. 10A
```

Select the maximum test current for the excitation test by pressing the corresponding key **([1]** - **[6])**.

f. If the selected test included a ratio test, the following screen will be displayed:

```
XFMR NAME PLATE RAT.
1. YES
2. NO
```

1. *YES*

   Press the **[1]** key if you would like to enter the CT nameplate values. The following screen will be displayed:

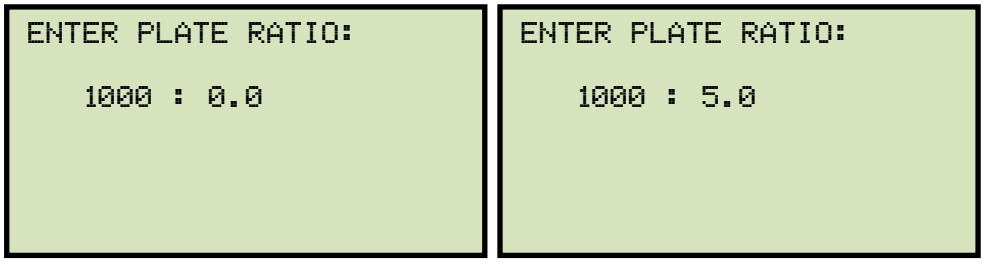
```
ENTER PLATE RATIO:

      0 :
```

   Type the first number using the keypad.

NOTE

You can press the **[CLEAR]** key to restart a field entry if necessary.

Press the **[ENTER]** key. The following screen will be displayed:

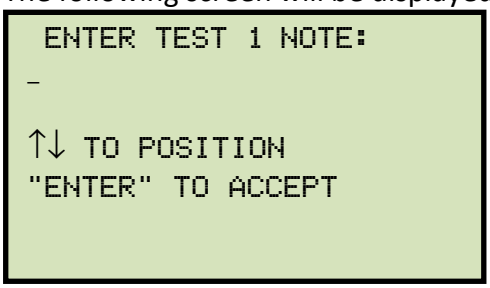


Type the second number using the keypad and then press the **[ENTER]** key. Continue to step g.

2. *NO*

   Press the **[2]** key if you do not want to enter the CT nameplate values. Continue to step g.

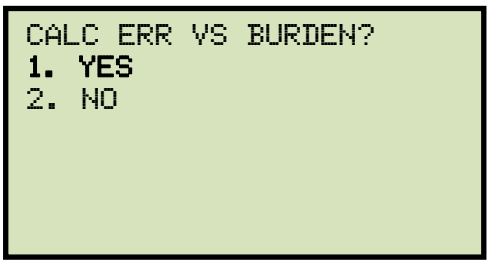
g. The following screen will be displayed:



Use the keypad to enter a test note. The test note field is 20 characters long. One test note can be saved for each test.

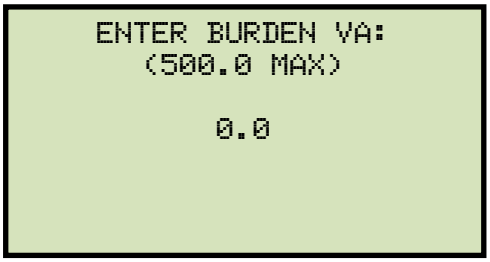
Press the **[ENTER]** key when you are done typing the note.

h. The following screen will be displayed:



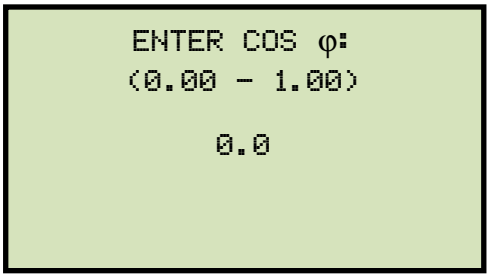
Press the **[1]** key (*YES*). Selecting this option will print the current ratio error table and current phase error table as part of the tabulated test results. Please see Figure 11, items 19 and 20.

i. The following screen will be displayed:



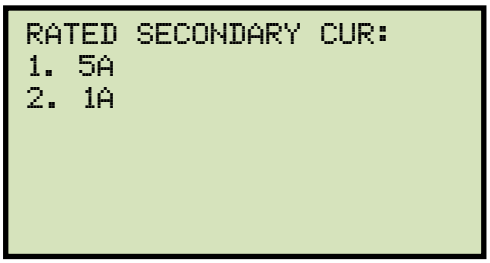
Type the burden value using the keypad and then press the **[ENTER]** key.

j. The following screen will be displayed:



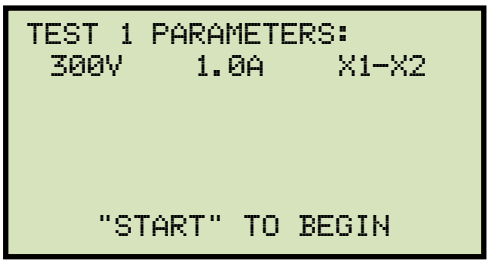
Type the Cos φ value using the keypad and then press the **[ENTER]** key.

k. The following screen will be displayed:



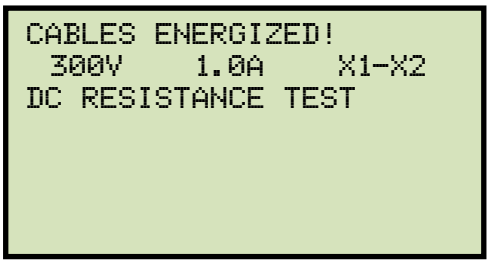
Select the rated secondary current by pressing the **[1]** key (*5A*) or **[2]** key (*1A*).

l. The following screen will be displayed showing a summary of the test parameters:

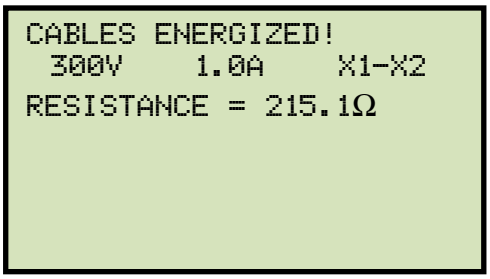


Press the **[START]** key to start the test.

m. If the selected test included a resistance test, the following screen will be displayed momentarily:



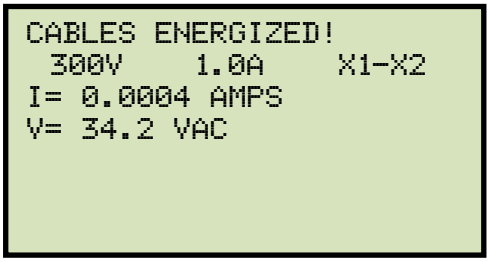
The following screen will then be displayed:



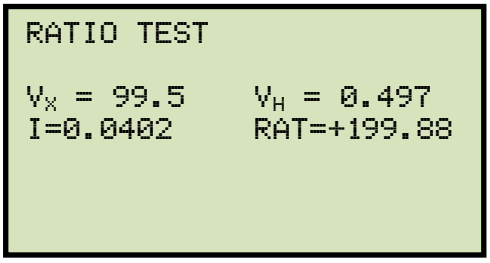
NOTE

The "HIGH VOLTAGE PRESENT" light will be illuminated to indicate that high voltage is present.

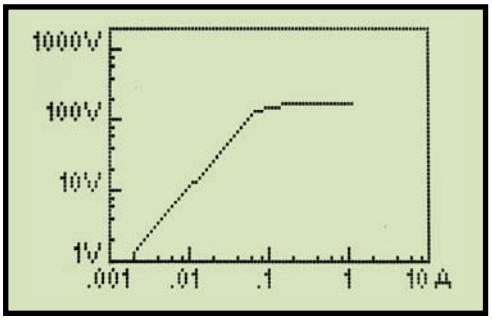
n. If the selected test included a ratio test, the following screen will be displayed momentarily:



The following screen will then be displayed:



When the testing is finished, the test results graph will be displayed:



Press any key on the keypad to continue.

o. The following screen will be displayed:

```
PRINT TEST RESULTS?
1. YES
2. NO
```

Press the **[1]** key (*YES*) if you would like to print the test results. The test results will be printed on the thermal printer. A typical EZCT-2000C tabulated test report printout is shown in Figure 11. A typical graphic report is shown in Figure 12.

Press the **[2]** key (*NO*) if you do not want to print the test results.

p. The following screen will be displayed:

```
KEEP THIS TEST?
1. YES
2. NO
```

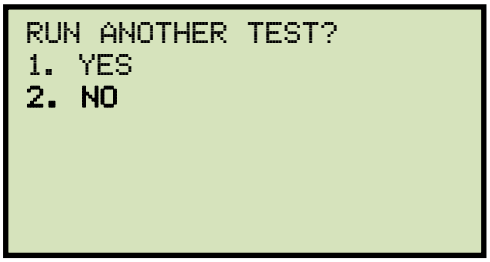
Press the **[1]** key (*YES*) to keep the test results.

q. The following screen will be displayed:

```
      TEST 1 SAVED
```

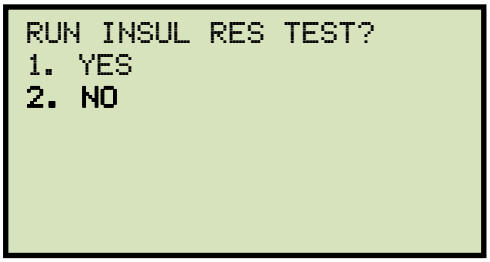
Press any key to continue.

r. The following screen will be displayed:



Press the **[2]** key (*NO*).

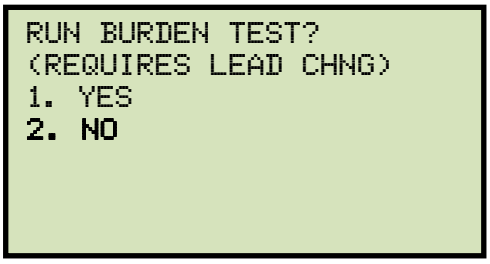
s. The following screen will be displayed:



Press the **[2]** key (*NO*).

If you would like to run the insulation resistance test as well, press the **[1]** key and then follow the instructions in section 3.3.4, steps c to f.

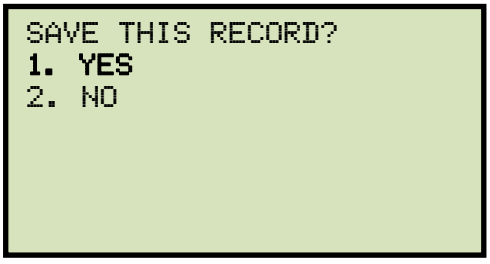
t. The following screen will be displayed:



Press the **[2]** key (*NO*).

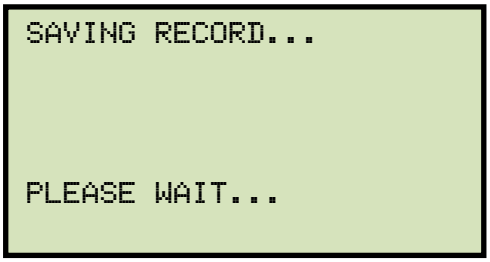
If you would like to run the burden test as well, press the **[1]** key and then follow the instructions in section 3.3.3, steps c to e.

u. The following screen will be displayed:

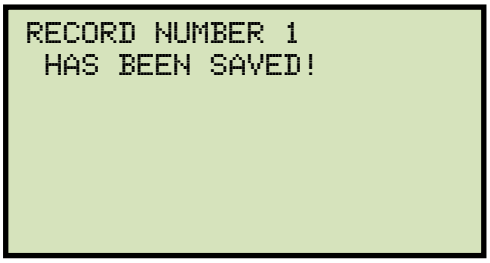


Press the **[1]** key (*YES*) to save the record.

The following screen will be displayed momentarily:



v. The following confirmation screen will then be displayed:



NOTE The test record number is automatically assigned to each test record stored in the EZCT-2000C's Flash EEPROM.

Press any key to return to the "START-UP" menu.

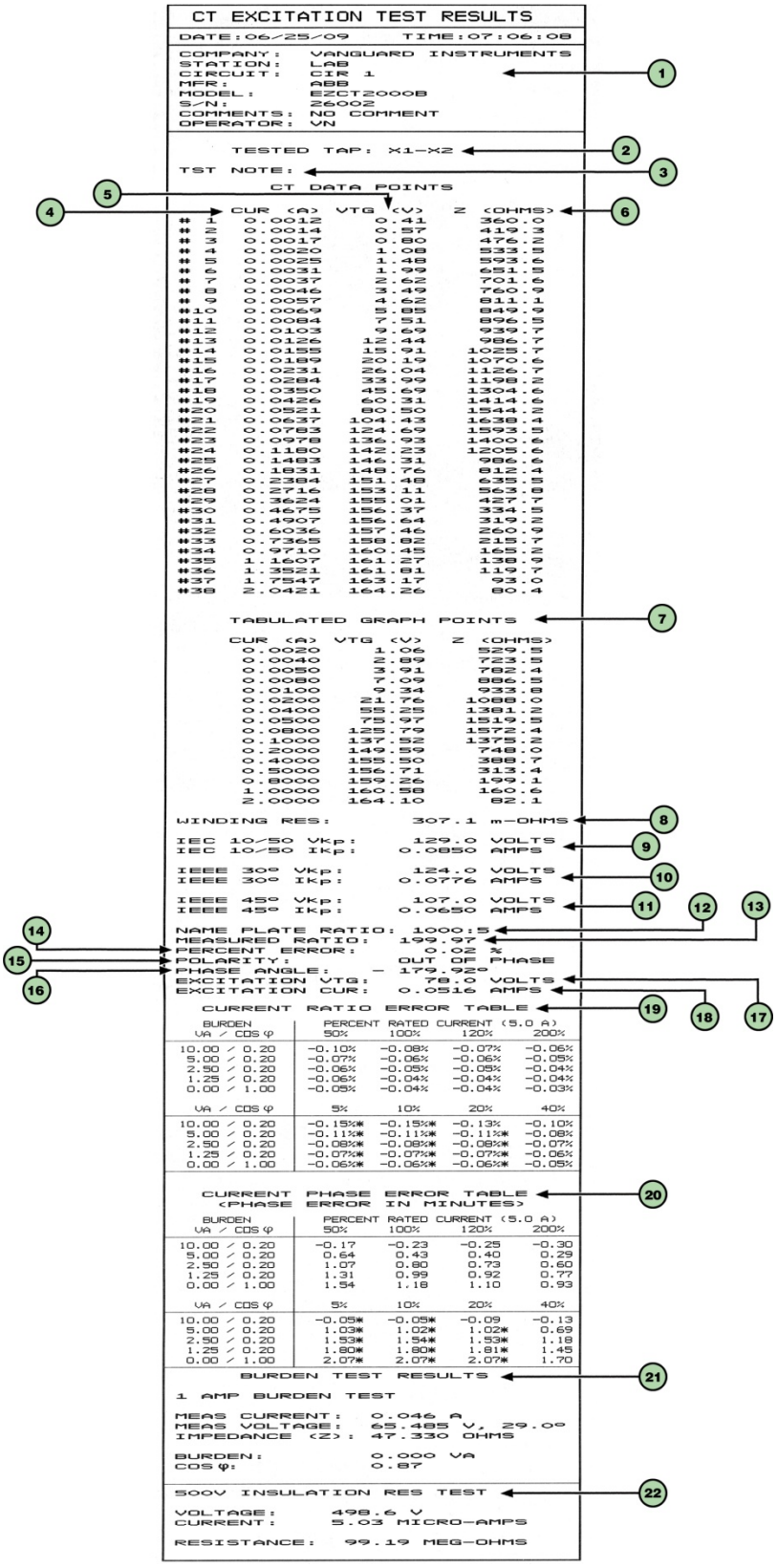


Figure 11. Typical EZCT-2000C Tabulated Report Printout

Table 4. Descriptions of Tabulated Test Results Elements

Item Number	Description
1	Test record header information.
2	The EZCT-2000C X terminals (taps) that were selected for this test.
3	Test note for this particular test. The test note can be up to 20-characters long.
4	Recorded excitation current readings on the CT secondary winding.
5	Recorded excitation test voltages applied to the CT secondary winding.
6	Impedance calculated at each data point.
7	The voltage, current, and impedance data points recorded on the graph grid-marks.
8	Measured DC resistance value of CT under test.
9	IEC 10/50 knee point voltage and excitation current (IEC 60044-1 10/50). This knee point voltage is the same as the ANSI 10/50 knee point voltage.
10	IEEE 30° knee point voltage and excitation current.
11	IEEE 45° knee point voltage and excitation current.
12	CT nameplate turns ratio.
13	Measured turns ratio.
14	Turns ratio percentage error.
15	Polarity of the CT.
16	Measured phase angle.
17	Excitation voltage used in CT turns ratio test.
18	Excitation current in turns ratio test.
19	Current ratio error table. This information will be printed only if you selected "YES" for the "CALC ERR VS BURDEN?" option when running a test. See section 3.3.2, step h for details.
20	Current phase error table. This information will be printed only if you selected "YES" for the "CALC ERR VS BURDEN?" option when running a test. See section 3.3.2, step h for details.
21	Burden test results. This information will be printed only if you chose to run the burden test. Please see section 3.3.2, step p for details.
22	Insulation resistance test results. This information will be printed only if you chose to run the insulation resistance test. Please see section 3.3.2, step o for details.

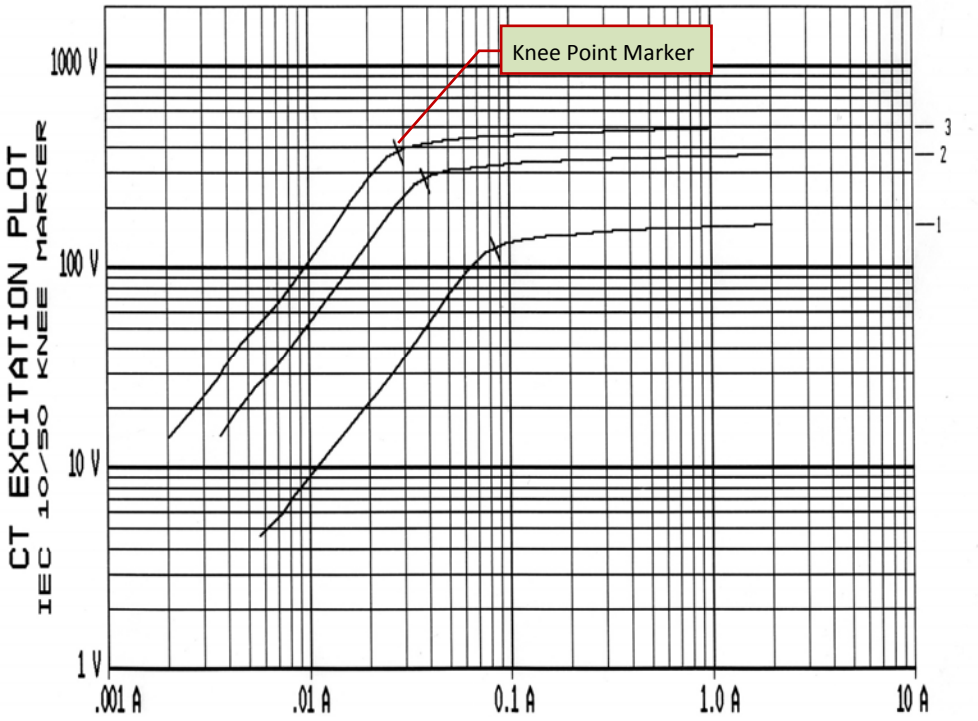
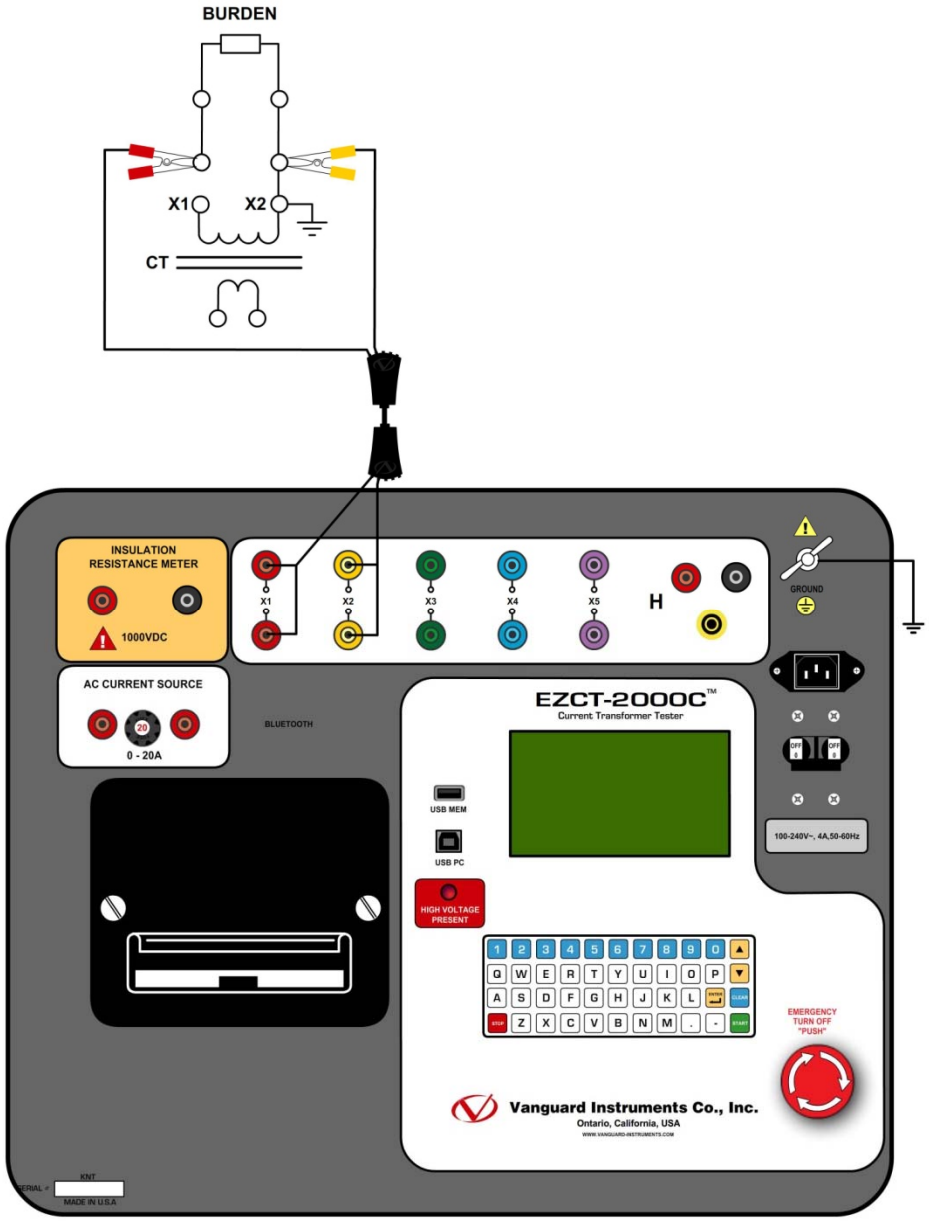


Figure 12. Typical EZCT-2000C Graphic Report with Multiple Plot Curves

3.3.3. Performing a CT Burden Test (EZCT-2000C Plus Only)

The CT burden test verifies the actual CT burden before putting the CT in service. The CT's secondary burden is measured by injecting a 1A or 5A test current into the load. To perform a CT burden test:

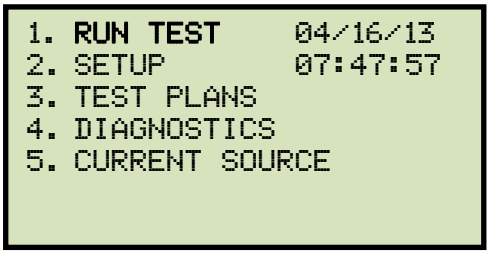
a. Make connections per the figure below:



NOTE

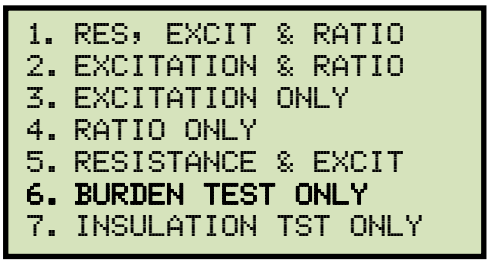
This test requires the X1 and X2 cables to be connected to the CT load burden.

b. Start from the "START-UP" menu:



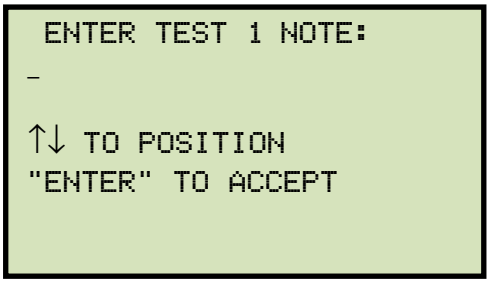
Press the **[1]** key (*RUN TEST*).

c. The following screen will be displayed:



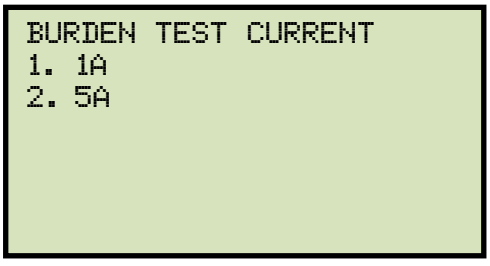
Press the **[6]** key (*BURDEN TEST ONLY*).

d. The following screen will be displayed:



Use the alpha-numeric keypad to enter a test note and then press the **[ENTER]** key.

e. The following screen will be displayed:



Select the burden test current by pressing either the **[1]** key (*1A*) or the **[2]** key (*5A*).

f. The following screen will be displayed:

```
TEST 1 PARAMETERS:
    1 AMP BURDEN TEST

CONNECT X1-X2 CABLES
TO BURDEN NOW.

    "START" TO BEGIN
```

Press the **[START]** key to begin the test.

g. The following screen will be displayed:

```
    CABLES ENERGIZED!

      I=0.0016 AMPS
      V= 1.2   VAC
```

NOTE

The "HIGH VOLTAGE PRESENT" light will be illuminated to indicate that high voltage is present.

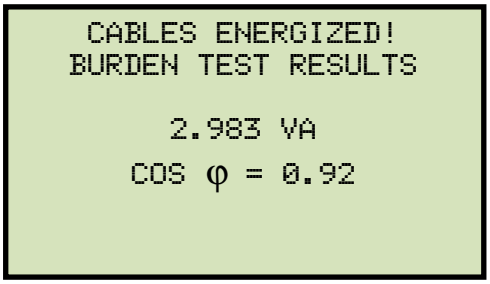
The following screen will be displayed momentarily:

```
    CABLES ENERGIZED!




     PLEASE WAIT...
```

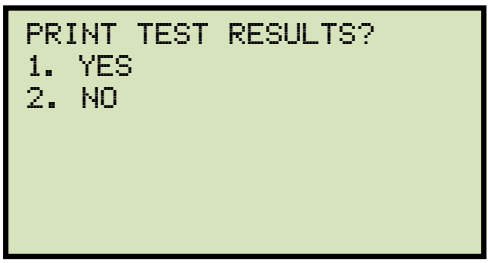
Then the following screen will be displayed:

```
    CABLES ENERGIZED!

      I=0.0018 AMPS
      V= 1.3   VAC
```

When the test is completed, the test results will be displayed temporarily:



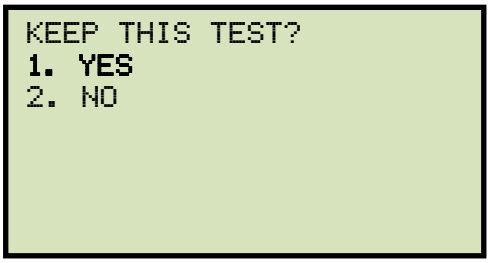
Then, the following screen will be displayed:



Print the **[1]** key (*YES*) if you would like to print the test results. The test results will be printed on the thermal printer. A typical burden test results report is shown in Figure 13.

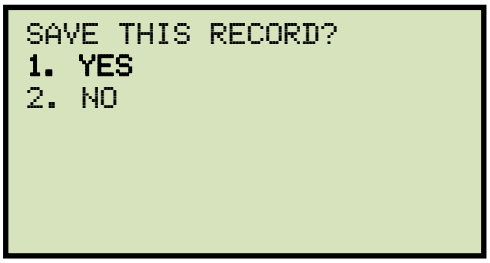
Press the **[2]** key (*NO*) if you do not want to print the test results.

h. The following screen will be displayed:

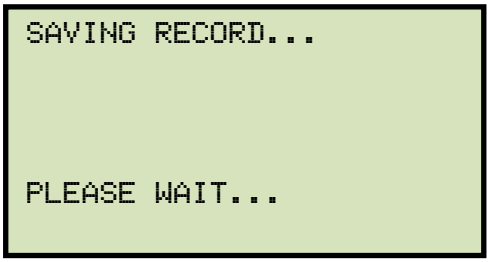


Press the **[1]** key (*YES*) to keep the test results.

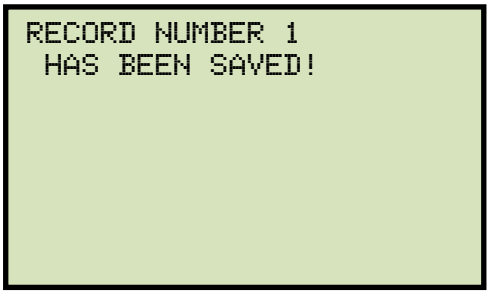
i. The following screen will be displayed:



Press the **[1]** key (*YES*) to save the test record. The following screen will be displayed momentarily:



j. The following confirmation screen will be displayed:



Press any key to return to the "START-UP" menu.

CT EXCITATION TEST RESULTS

DATE: 06/18/09 TIME: 10:11:57

COMPANY: VANGUARD
STATION:
CIRCUIT:
MFR:
MODEL:
S/N:
COMMENTS:
OPERATOR:

TST NOTE:

BURDEN TEST RESULTS

5 AMP BURDEN TEST

MEAS CURRENT: 5.002 A
MEAS VOLTAGE: 2.983 V, 23.1°
IMPEDANCE (Z): 0.60 OHMS

BURDEN: 15.02 VA
COS φ: 0.92

Figure 13. EZCT-2000C Typical Burden Test Results Report Printout

3.3.4. Performing an Insulation Resistance Test

To perform an insulation resistance test:

a. Make connections per Figure 12, 13, or 14 below:

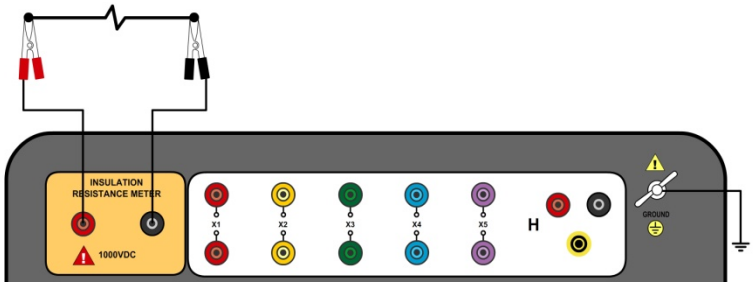


Figure 14. Connections for a typical high resistance measuring application

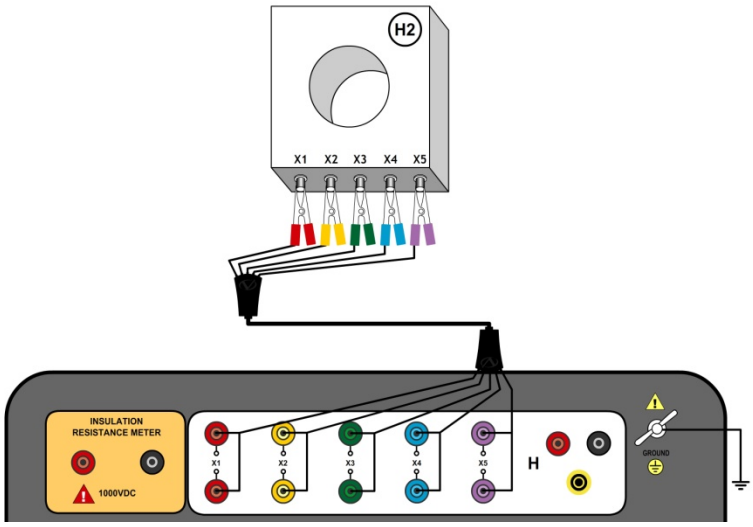


Figure 15. Connections for a typical insulation resistance measurement for a CT with 5 terminals

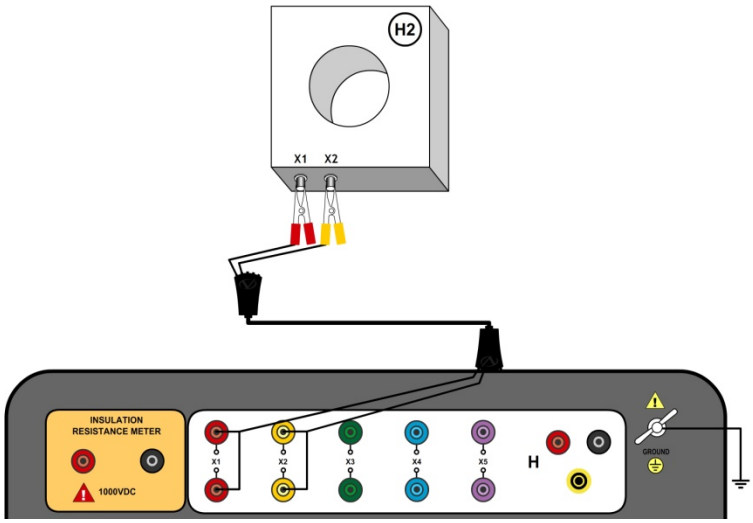
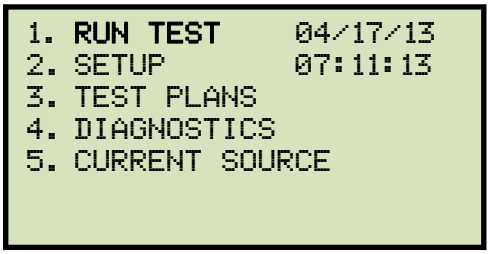


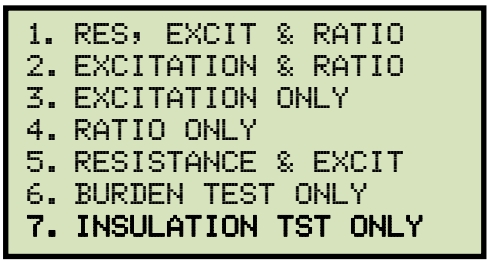
Figure 16. Connections for a typical insulation resistance measurement for a CT with 2 terminals

b. Start from the "START-UP" menu:



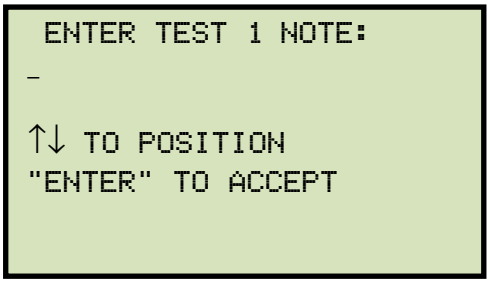
Press the **[1]** key (*RUN TEST*).

c. The following screen will be displayed:



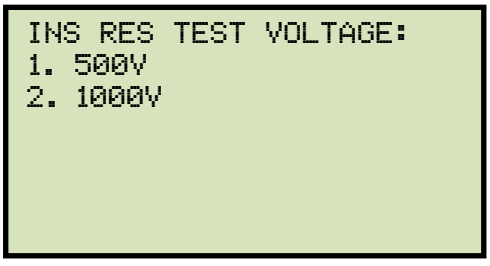
Press the **[7]** key (*INSULATION TST ONLY*)

d. The following screen will be displayed:



Use the alpha-numeric keypad to enter a test note and then press the **[ENTER]** key.

e. The following screen will be displayed:



Select the test voltage by pressing either the **[1]** key (*500V*) or the **[2]** key (*1000V*).

f. The following screen will be displayed:

```
TEST 1 PARAMETERS
  500V INS RES TEST

CONNECT INS REST TEST
CABLES NOW.

 "START" TO BEGIN
```

Connect the insulation resistance cables and then press the **[START]** key.

g. The following screen will be displayed:

```
   CABLES ENERGIZED!




  INSULATION RES TEST
```

NOTE

The "HIGH VOLTAGE PRESENT" light will be illuminated to indicate that high voltage is present.

When the test is completed, the test results will be displayed temporarily:

```
   CABLES ENERGIZED!

       493.7 V
       864 µA
     150.0 MEG Ω


  INSULATION RES TEST
```

The following screen will then be displayed:

```
PRINT TEST RESULTS?
1. YES
2. NO
```

Press the **[1]** key (*YES*) if you would like to print the test results. The test results will be printed on the thermal printer. A typical insulation resistance test results report is shown in Figure 17.

Press the **[2]** key (*NO*) if you do not want to print the test results.

h. The following screen will be displayed:

```
KEEP THIS TEST?
1. YES
2. NO
```

Press the **[1]** key (*YES*) to keep the test results.

i. The following screen will be displayed:

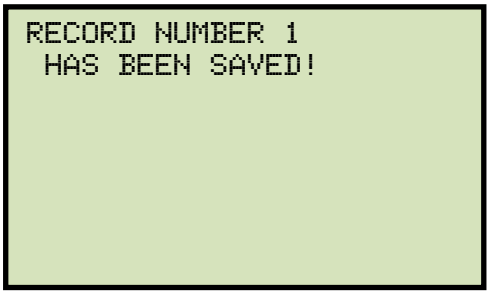
```
SAVE THIS RECORD?
1. YES
2. NO
```

Press the **[1]** key (*YES*) to save the record.

The following screen will be displayed momentarily:

```
SAVING RECORD...



PLEASE WAIT...
```

j. The following confirmation screen will then be displayed:



Press any key to return to the "START-UP" menu.

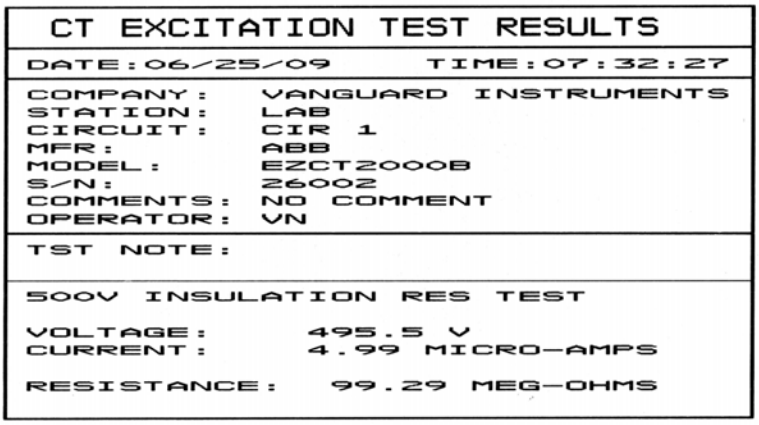
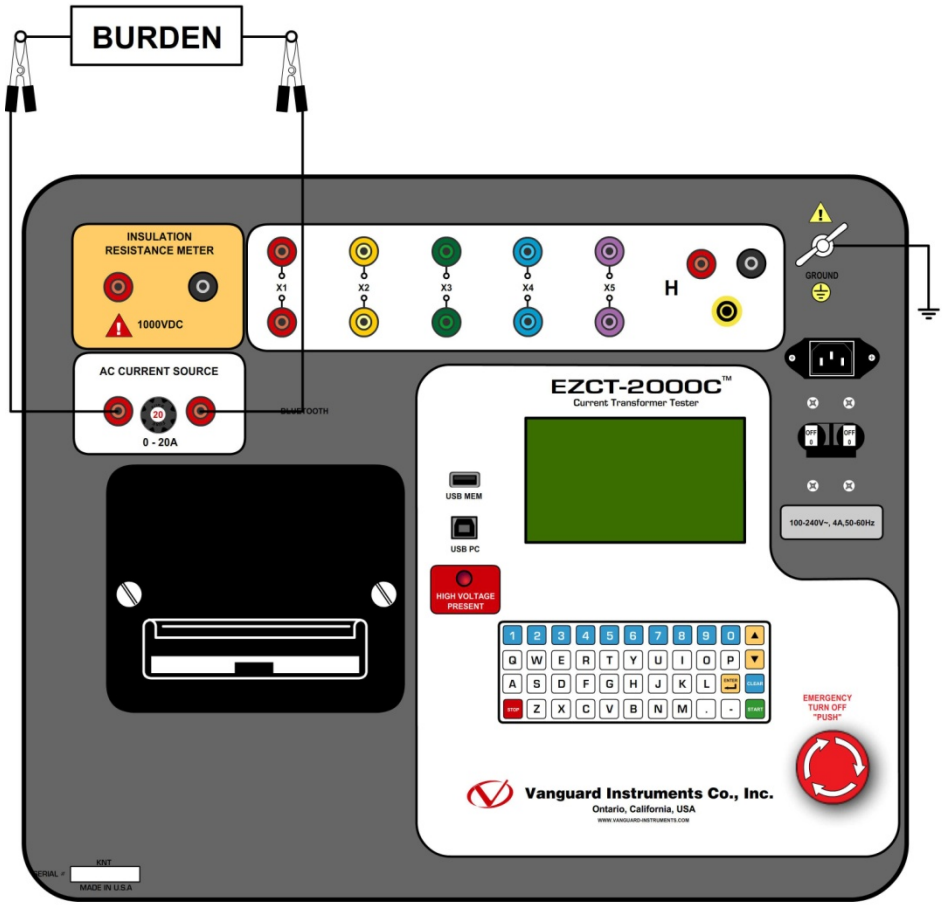


Figure 17. EZCT-2000C Typical Insulation Resistance Test Results Report Printout

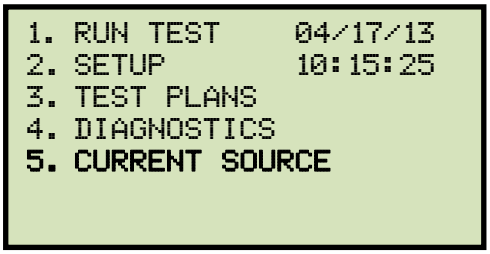
3.3.5. Performing a Current Source Test (EZCT-2000C Plus Only)

The EZCT-2000C Plus's programmable current source can be used to verify CT loads. The EZCT-2000C Plus can output up to a 20A current (0-15Vac). To perform a current source test:

a. Make connections per the figure below:

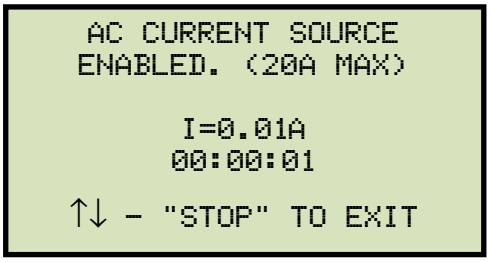


b. Start from the "START-UP" menu:



Press the **[5]** key (*CURRENT SOURCE*).

c. The following screen will be displayed:



Press and hold the **[∧]** key to increase the current. Press and hold the **[∨]** key to decrease the current. A timer will display the elapsed time that the current has been on.

NOTE

The EZCT-2000C is thermally protected and will automatically shut off if the transformer reaches an over-temperature condition. Since the EZCT-2000C can provide up to a 20A current, the transformer can get to thermal protection mode if operated for a long time at a high current. A very long cool-down period may be required for such cases.

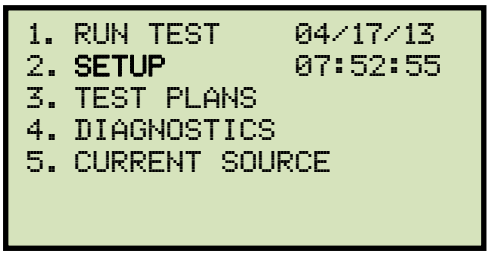
d. Press the **[STOP]** key to turn off the current source and return to the "START-UP" menu.

3.4 Working With Test Records

3.4.1. Restoring and Printing a Test Record From Flash EEPROM

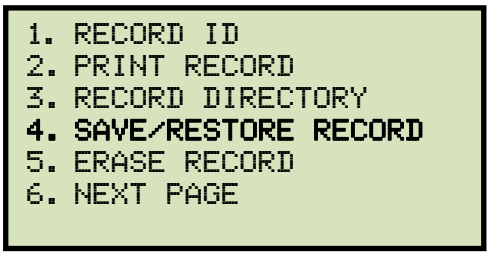
You can restore a test record from the EZCT-2000C's Flash EEPROM to the working memory. You can then print the restored test record on the unit's built-in thermal printer. To restore a test record:

a. Start from the "START-UP" menu:



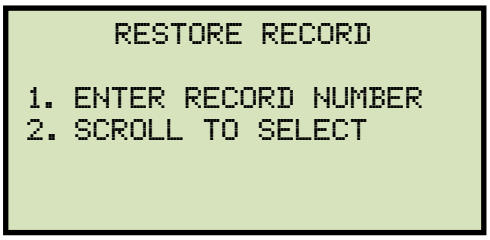
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



Press the **[4]** key (*SAVE/RESTORE RECORD*).

c. The following screen will be displayed:

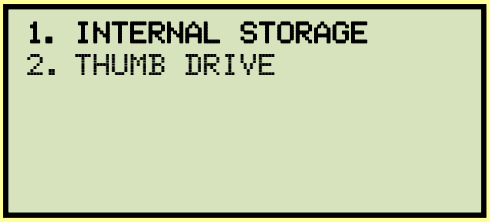


NOTE

If you have a USB Flash drive inserted in the EZCT-2000C's "USB MEM" port, the following screen will be displayed instead of the above screen:

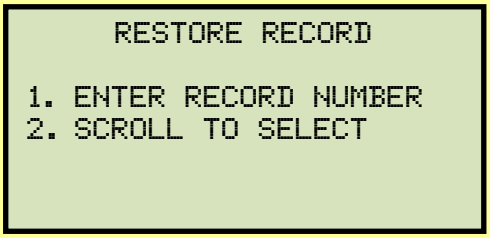
Press the **[1]** key (*RESTORE RECORD*).

The following screen will be displayed:



Press the **[1]** key (*INTERNAL STORAGE*).

The following screen will then be displayed:



Continue with the steps below.

1. *ENTER RECORD NUMBER*

   If you know the record number that you would like to restore, press the **[1]** key. The following screen will be displayed:

   Type the record number using the keypad and then press the **[ENTER]** key. The following screen will be displayed:

   If you do not want to print the test record, press the **[2]** key (*NO*). The test record will be restored to the working memory, and you will be returned to the "START-UP" menu.

   If you would like to print the test record, press the **[1]** key (*YES*). Continue to step d.

2. *SCROLL TO SELECT*

Press the **[2]** key if you would like to scroll through a directory of the stored test records. The following screen will be displayed:

```
    RECORD DIRECTORY

"UP" TO SCROLL FWD
"DWN" TO SCROLL RVS
```

Press the **[∧]** or the **[∨]** key to display the next or previous test record, respectively. The test record information will be displayed as shown:

```
#1     04/17/13   10:11
5 TESTS
LAB
CIR 1
ABB
EZCT2000B
SN 1
```

When you have located the test record that you would like to restore, press the **[ENTER]** key.

The following screen will be displayed:

```
  RECORD RESTORED!
   PRINT RECORD?
1. YES
2. NO
```

If you do not want to print the test record, press the **[2]** key (*NO*). The test record will be restored to the working memory, and you will be returned to the "START-UP" menu.

If you would like to print the test record, press the **[1]** key (*YES*). Continue to step d.

d. The following screen will be displayed:

```
     PRINT OPTIONS:
1. FULL DATA
2. ABBREVIATED DATA
```

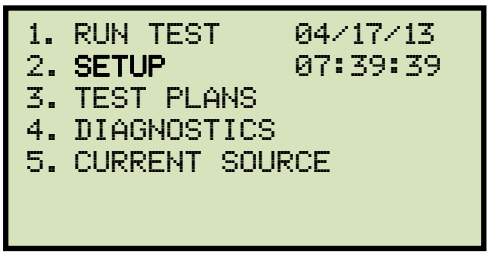
Press the **[1]** key to print the tabulated data and graphics results on the thermal printer. The test record will be restored to the working memory and will be printed on the thermal printer, and then you will be returned to the "START-UP" menu.

Press the **[2]** key to print the test report and graphic results on the thermal printer, without the excitation voltage and current data points. The test record will be restored to the working memory and will be printed on the thermal printer, and then you will be returned to the "START-UP" menu.

3.4.2. Restoring and Printing a Test Record From a USB Flash Drive

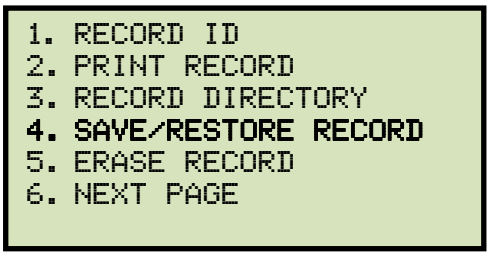
You can restore a test record from a USB Flash drive to the EZCT-2000C's working memory using the steps below:

a. Make sure the USB Flash drive containing the test record(s) is inserted in the EZCT-2000C's USB Flash drive port ("USB MEM" port). Then start from the "START-UP" menu:



Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:

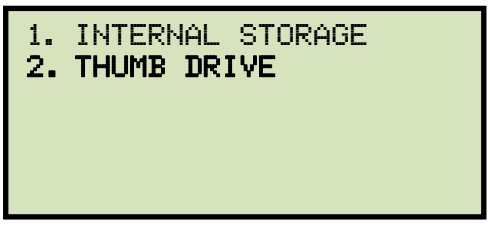


Press the **[4]** key (*SAVE/RESTORE RECORD*).

c. The following screen will be displayed:

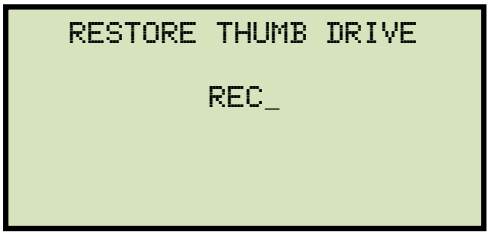
Press the **[1]** key (*RESTORE RECORD*).

d. The following screen will be displayed:



Press the **[2]** key (*THUMB DRIVE*).

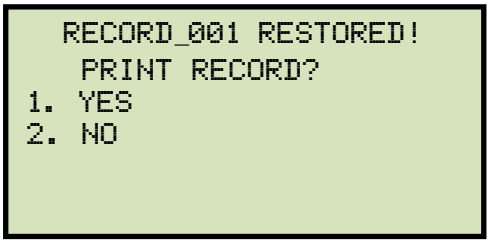
e. The following screen will be displayed:



Type the record number that you would like to restore and press the **[ENTER]** key. If you do not know the record number, you can print a test record directory. Please see section 3.4.5 for details.

f. The following screen will be displayed while the record is being restored:

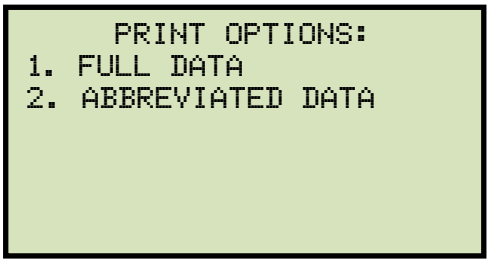
The following screen will be displayed once the test record has been restored:



If you do not want to print the test record, press the **[2]** key (*NO*). The test record will be restored to the working memory, and you will be returned to the "START-UP" menu.

If you would like to print the test record, press the **[1]** key (*YES*). Continue to step g.

g. The following screen will be displayed:



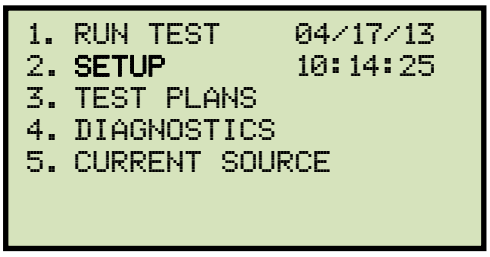
Press the **[1]** key to print the full tabulated data and graphics results on the thermal printer. After printing is finished, you will be returned to the "START-UP" menu.

Press the **[2]** key to print the test report and graphic results on the thermal printer, without the excitation voltage and current data points. After printing has finished, you will be returned to the "START-UP" menu.

3.4.3. Printing a Restored Test Record

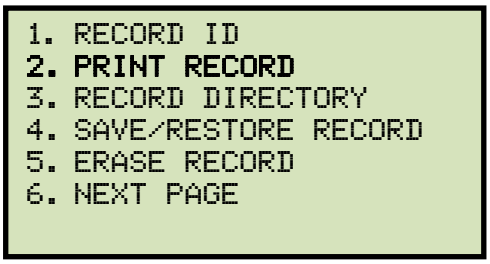
You can print a test record at the time that it is restored from the Flash EEPROM or a USB Flash drive (see section 3.4.1), or you can restore it to the working memory and print it later. To print the current test record in the working memory:

a. Start from the "START-UP" menu:



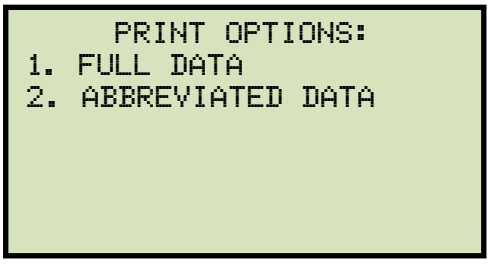
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



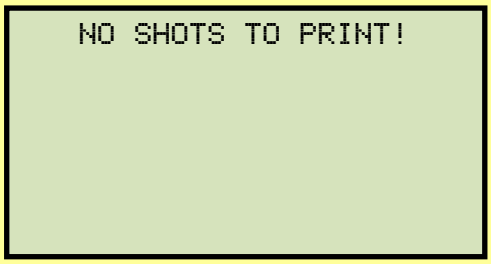
Press the **[2]** key (*PRINT RECORD*).

c. The following screen will be displayed:



NOTE

If there is no test record in the working memory, the following screen will be displayed:



Press any key to return to the "START-UP" menu. Please see section 3.4.1 for instructions on how to restore a test record.

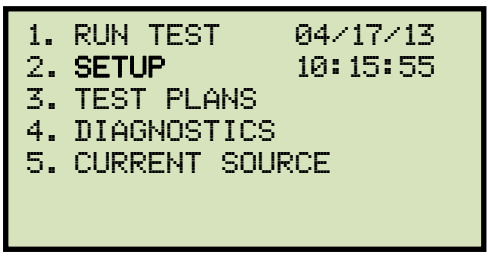
Press the **[1]** key to print the tabulated data and graphics results on the thermal printer. The test record will be printed on the thermal printer and you will be returned to the "START-UP" menu.

Press the **[2]** key to print the test report and graphic results on the thermal printer, without the excitation voltage and current data points. The test record will be printed on the thermal printer and you will be returned to the "START-UP" menu.

3.4.4. Printing a Directory of Test Records Stored in the EZCT-2000C's Memory

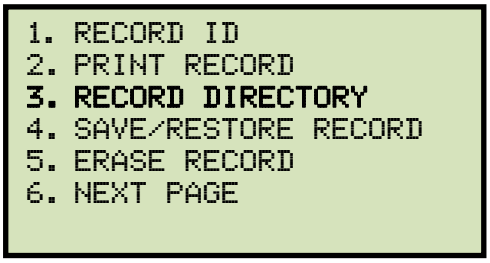
You can print a directory of all the test records stored in the EZCT-2000C's Flash EEPROM using the steps below:

a. Start from the "START-UP" menu:



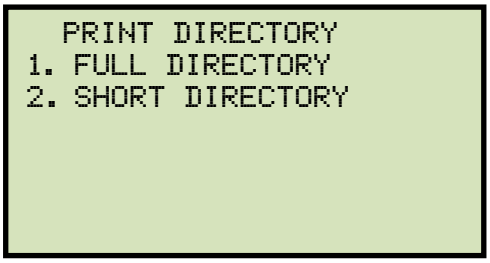
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



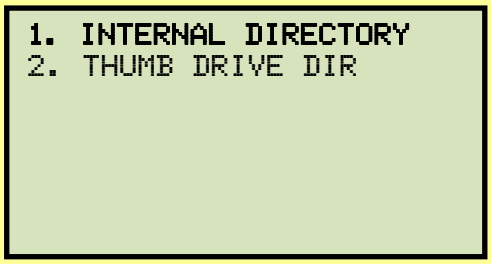
Press the **[3]** key (*RECORD DIRECTORY*).

c. The following screen will be displayed:

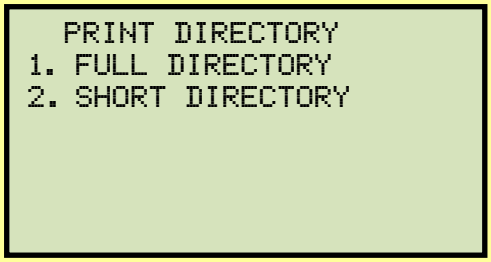


NOTE

The above screen will be displayed only if a USB Flash drive is NOT connected to the EZCT-2000C's USB Flash drive port. If a USB Flash drive is connected, the following screen will be displayed:



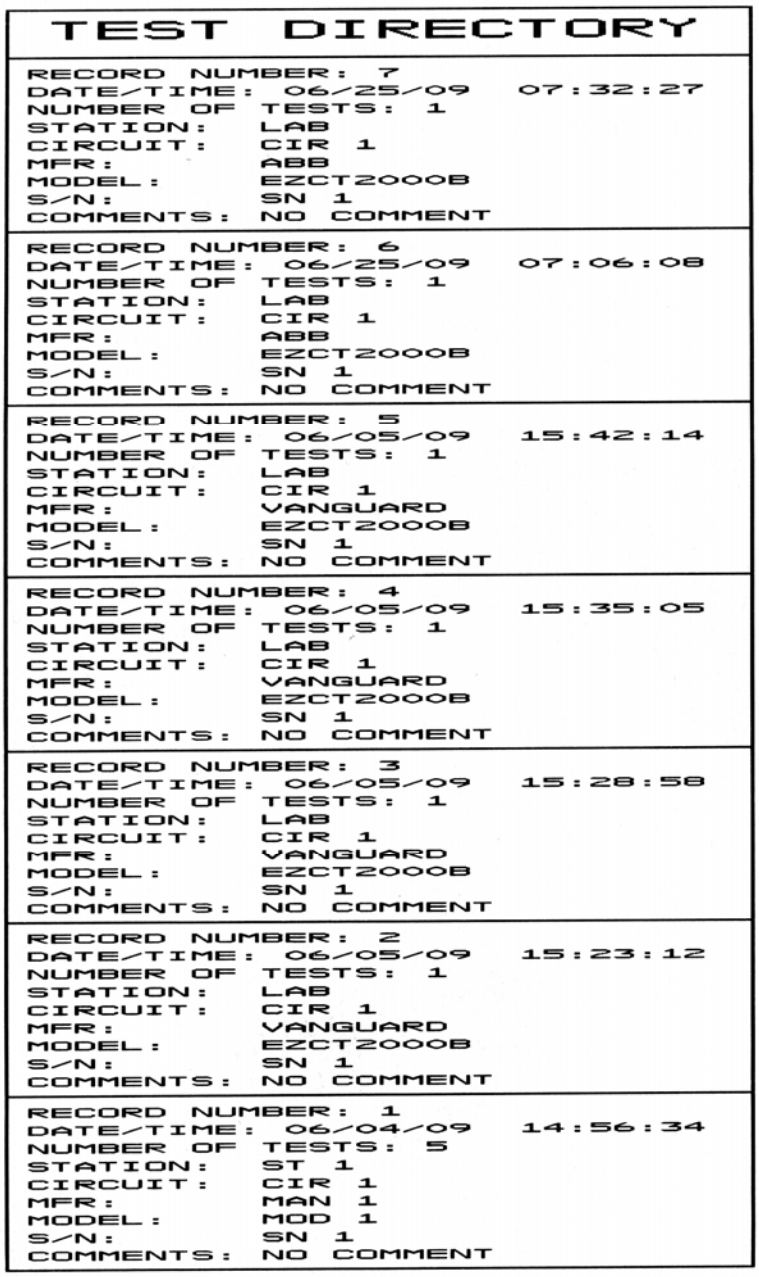
Press the **[1]** key (*INTERNAL DIRECTORY*). The following screen will be displayed:



Continue with the steps below:

Press the **[1]** key to print a full directory listing of all the test records stored in the EZCT-2000C's Flash EEPROM. The directory listing will be printed on the thermal printer and you will be returned to the "START-UP" menu. A sample directory listing printout is shown in Figure 18.

Press the **[2]** key to print a short directory listing of the stored test records. The short directory option prints the last 10 records stored in the EZCT-2000C's Flash EEPROM. The short directory listing will be printed on the thermal printer and you will be returned to the "START-UP" menu.



TEST DIRECTORY

RECORD NUMBER: 7
DATE/TIME: 06/25/09 07:32:27
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: ABB
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

RECORD NUMBER: 6
DATE/TIME: 06/25/09 07:06:08
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: ABB
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

RECORD NUMBER: 5
DATE/TIME: 06/05/09 15:42:14
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: VANGUARD
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

RECORD NUMBER: 4
DATE/TIME: 06/05/09 15:35:05
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: VANGUARD
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

RECORD NUMBER: 3
DATE/TIME: 06/05/09 15:28:58
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: VANGUARD
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

RECORD NUMBER: 2
DATE/TIME: 06/05/09 15:23:12
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: VANGUARD
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

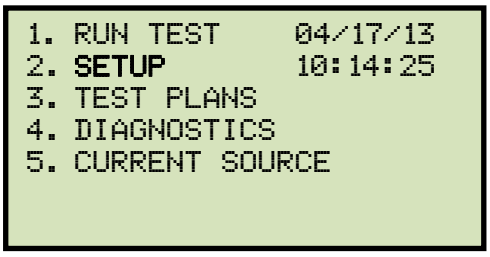
RECORD NUMBER: 1
DATE/TIME: 06/04/09 14:56:34
NUMBER OF TESTS: 5
STATION: ST 1
CIRCUIT: CIR 1
MFR: MAN 1
MODEL: MOD 1
S/N: SN 1
COMMENTS: NO COMMENT

Figure 18. Typical Internal Test Record Directory Printout

3.4.5. Printing a Directory of Test Records Stored in a USB Flash Drive

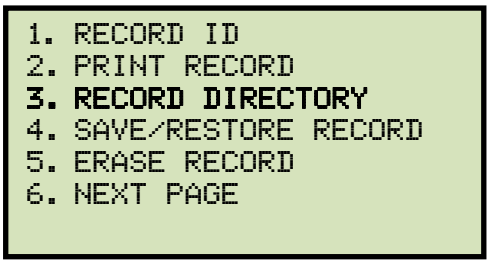
You can print a directory of all the test records stored in a USB Flash drive using the steps below:

a. Make sure the USB Flash drive is inserted in the EZCT-2000C's USB Flash drive port ("USB MEM" port). Then start from the "START-UP" menu:



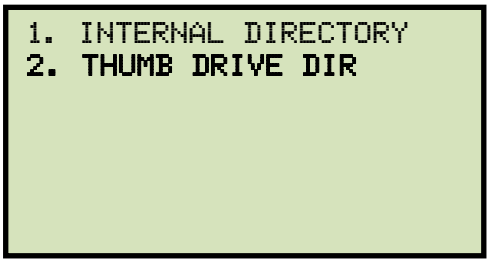
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



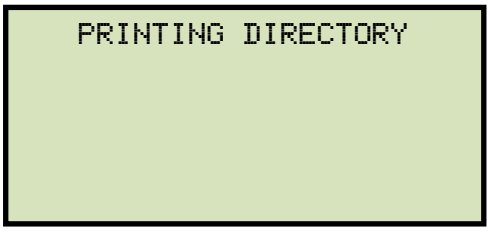
Press the **[3]** key (*RECORD DIRECTORY*).

c. The following screen will be displayed:

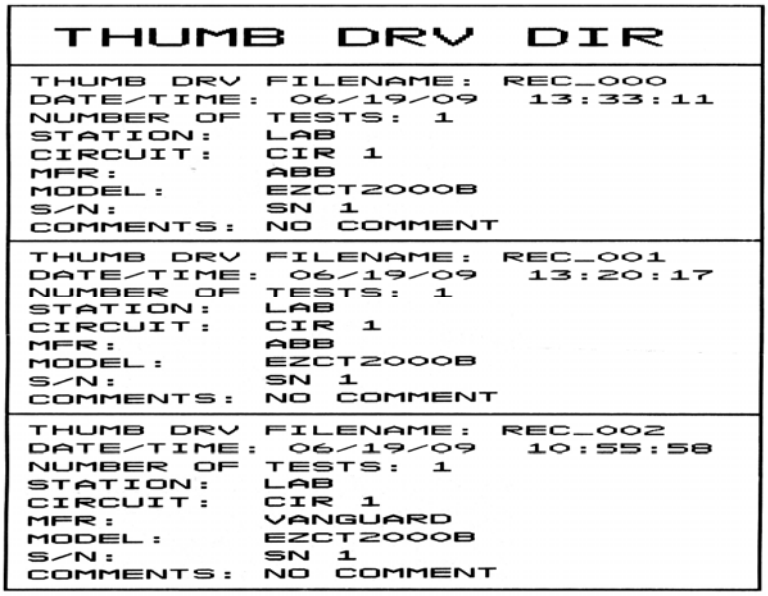


Press the **[2]** key (*THUMB DRIVE DIR*).

d. The following screen will be displayed while the directory is printed:



When printing is finished, you will be returned to the "START-UP" menu. A sample directory printout is shown in Figure 19.



THUMB DRV DIR

THUMB DRV FILENAME: REC_000
DATE/TIME: 06/19/09 13:33:11
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: ABB
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

THUMB DRV FILENAME: REC_001
DATE/TIME: 06/19/09 13:20:17
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: ABB
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

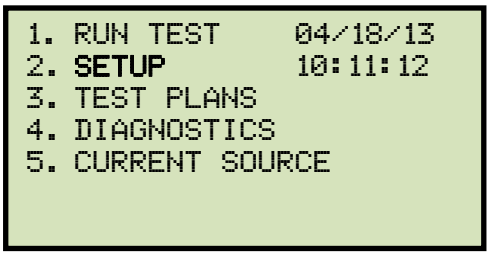
THUMB DRV FILENAME: REC_002
DATE/TIME: 06/19/09 10:55:58
NUMBER OF TESTS: 1
STATION: LAB
CIRCUIT: CIR 1
MFR: VANGUARD
MODEL: EZCT2000B
S/N: SN 1
COMMENTS: NO COMMENT

Figure 19. Typical USB Flash Drive Record Directory Printout

3.4.6. Copying Test Records to a USB Flash Drive

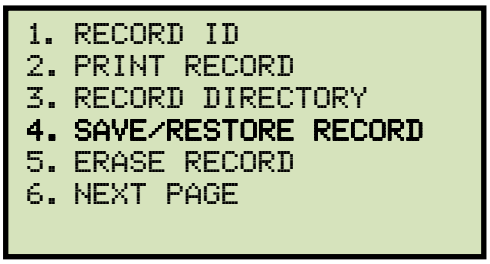
You can easily copy test records stored in the EZCT-2000C's Flash EEPROM to a connected USB Flash drive using the steps below:

a. Make sure a USB Flash drive is inserted in the EZCT-2000C's Flash drive port ("USB MEM" port). Then start from the "START-UP" menu:



Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:

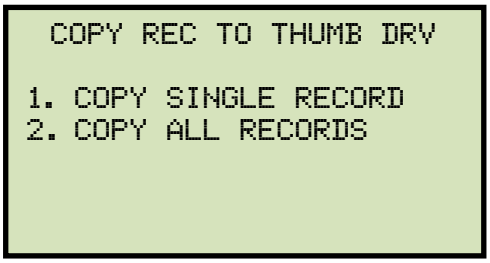


Press the **[4]** key (*SAVE/RESTORE RECORD*).

c. The following screen will be displayed:

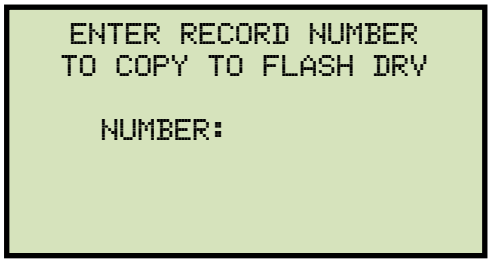
Press the **[2]** key (*COPY TO THUMB DRIVE*).

d. The following screen will be displayed:



1. *COPY SINGLE RECORD*

Press the **[1]** key (*COPY SINGLE RECORD*) if you would like to copy a single record from the EZCT-2000C to the USB Flash drive. The following screen will be displayed:

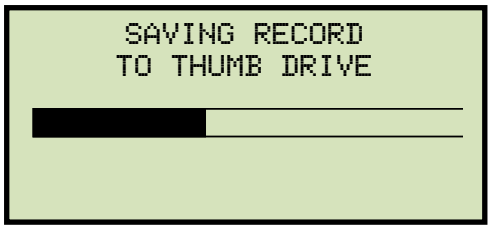


Type the record number that you would like to copy to the USB Flash drive and then press the **[ENTER]** key.

NOTE

If you do not know the record number, you can first print a test record directory using the instructions in section 3.4.4.

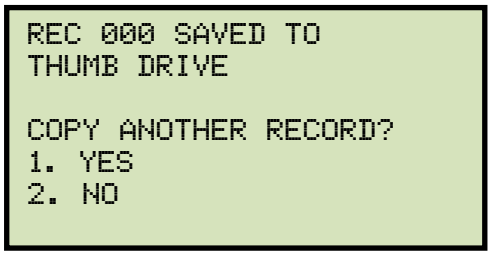
The following screen will be displayed showing the status of the copy process:



NOTES

Any existing test records on the USB Flash drive will NOT be erased. The EZCT-2000C will automatically increment the record number for newly copied test records.

After the record has been copied, the following screen will be displayed:

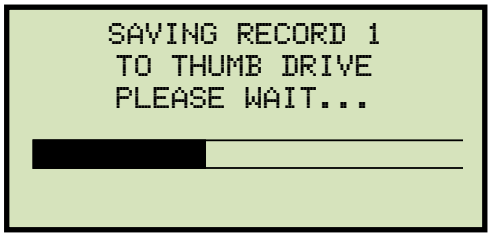


Press the **[1]** key (*YES*) if you would like to copy another record and repeat the process above.

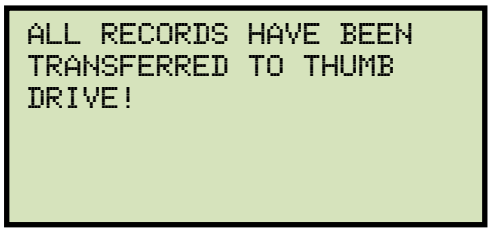
Press the **[2]** key (*NO*) to return to the "START-UP" menu.

2. *COPY ALL RECORDS*

Press the **[2]** key (COPY ALL RECORDS) if you would like to copy all the test records from the EZCT-2000C to the USB Flash drive. The following screen will be displayed:



The above progress screen will be displayed for each test record being copied. When all the test records have been copied, the following screen will be displayed:

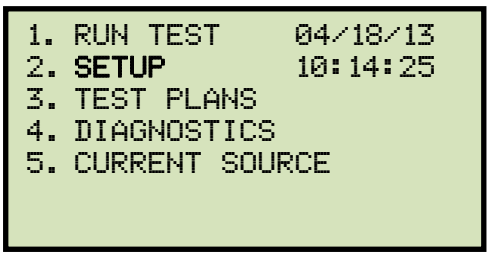


Press any key to return to the "START-UP" menu.

3.4.7. Erasing Test Records From the Flash EEPROM

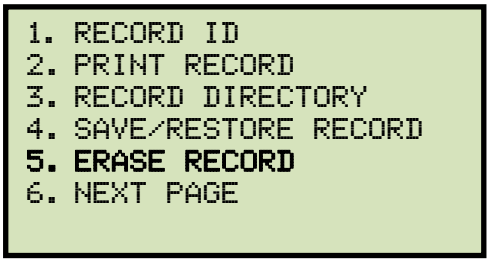
You can erase individual or all test records stored in the EZCT-2000C's Flash EEPROM. To erase a test record:

a. Start from the "START-UP" menu:



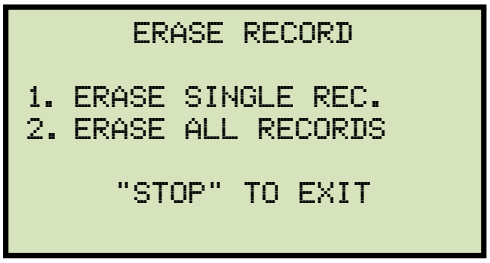
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



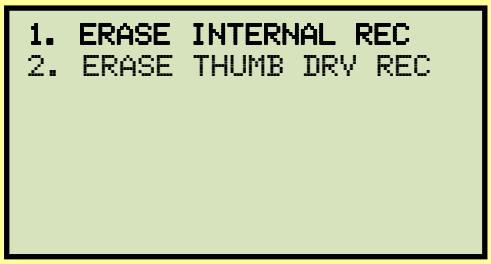
Press the **[5]** key (*ERASE RECORD*).

c. The following screen will be displayed:



NOTE

The above screen will be displayed only if a USB Flash drive is NOT connected to the EZCT-2000C's USB Flash drive port. If a USB Flash drive is connected, the following screen will be displayed:



Press the **[1]** key (*ERASE INTERNAL REC*). The following screen will be displayed:

```
      ERASE RECORD

1. ERASE SINGLE REC.
2. ERASE ALL RECORDS

     "STOP" TO EXIT
```

Continue with the steps below:

1. *ERASE SINGLE REC.*

Press the **[1]** key if you would like to erase a single record. The following screen will be displayed:

```
      ERASE RECORD
      NUMBER:
```

Type the record number to be erased and press the **[ENTER]** key.

NOTES

- You can press the **[STOP]** key to cancel the process.
- If you do not know the record number, you can first print a test record directory using the instructions in section 3.4.4.

The following screen will be displayed momentarily:

```
     ERASING RECORD
     NUMBER: 01

    PLEASE WAIT...
```

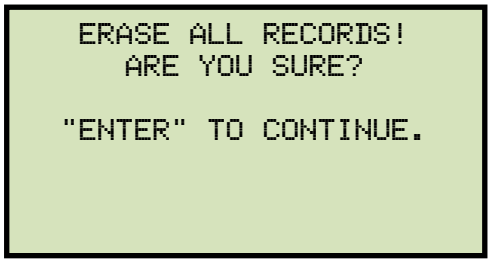
Then the following confirmation screen will be displayed:

```
RECORD NUMBER 1
 ERASED!
```

Press any key to return to the "START-UP" menu.

2. *ERASE ALL RECORDS*

Press the **[2]** key if you would like to erase all of the test records stored in the EZCT-2000C's flash EEPROM. The following confirmation screen will be displayed:



If you would like to cancel the erasure process, press the **[STOP]** key. No records will be erased and you will be returned to the "START-UP" menu.

Press the **[ENTER]** key to continue with the erasure process. The following screen will be displayed while the records are being erased:

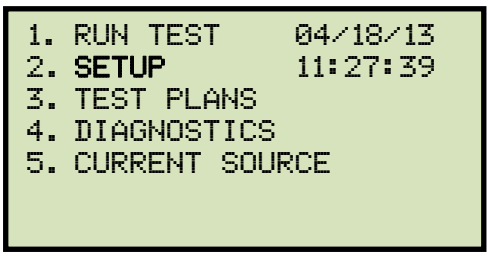
The following screen will be displayed after all of the test records have been erased:

Press any key to return to the "START-UP" menu.

3.4.8. Erasing Test Records From a USB Flash Drive

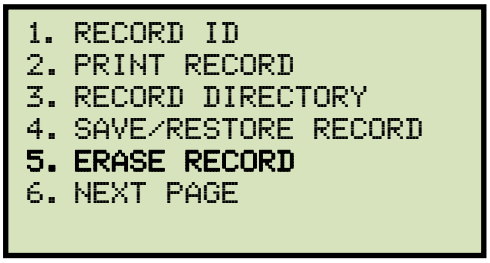
You can erase individual or all test records stored in a USB Flash drive. To erase a test record:

a. Make sure the USB Flash drive is inserted in the EZCT-2000C's USB Flash drive port ("USB MEM" port). Then start from the "START-UP" menu:



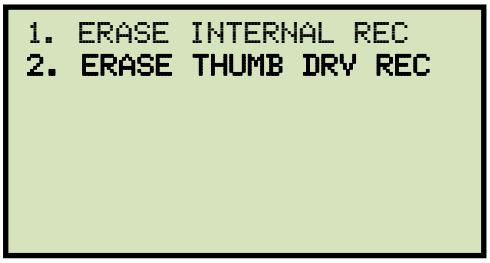
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



Press the **[5]** key (*ERASE RECORD*).

c. The following screen will be displayed:



Press the **[2]** key (*ERASE THUMB DRV REC*).

d. The following screen will be displayed:

```
      ERASE RECORD

1. ERASE SINGLE REC.
2. ERASE ALL RECORDS


     "STOP" TO EXIT
```

1. *ERASE SINGLE REC.*

Press the **[1]** key (*ERASE SINGLE REC.*) if you would like to erase a single record. The following screen will be displayed:

```
    ERASE THUMB DRIVE
        REC_
```

Type the record number to be erased and press the **[ENTER]** key.

NOTES

- You can press the **[STOP]** key to cancel the process.
- If you do not know the record number, you can first print a test record directory using the instructions in section 3.4.5.

The following screen will be displayed:

```
THUMB DRIVE REC_001
ERASED!
```

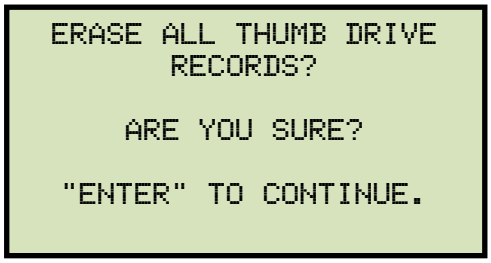
Press any key to continue. The following screen will be displayed:

```
      ERASE RECORD

1. ERASE SINGLE REC.
2. ERASE ALL RECORDS


     "STOP" TO EXIT
```

You can continue to erase additional records or press the **[STOP]** key to exit to the "START-UP" menu.

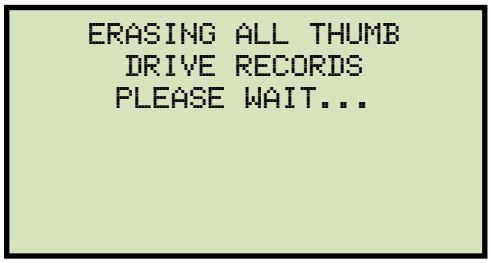
2. *ERASE ALL RECORDS*

Press the **[2]** key (*ERASE ALL RECORDS*) if you would like to erase all of the test records stored in the USB Flash drive. The following confirmation screen will be displayed:

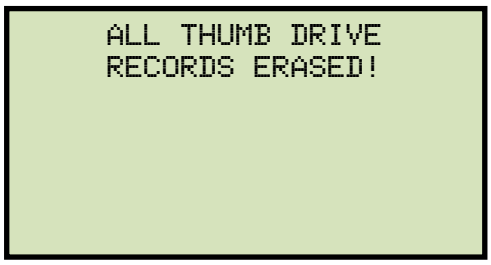


If you would like to cancel the erasure process, press the **[STOP]** key. No records will be erased and you will be returned to the "START-UP" menu.

Press the **[ENTER]** key to continue with the erasure process. The following screen will be displayed while the records are being erased:



The following screen will be displayed after all of the test records have been erased:



Press any key to return to the "START-UP" menu.

3.5 Working With Test Plans

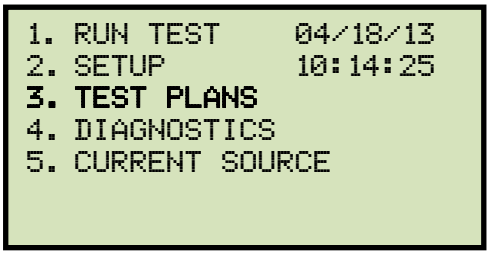
A test plan is comprised of the saturation test voltage, current range selection, CT nameplate ratios, and CT winding terminal combinations (X1 to X5) for each test, and also includes the insulation resistance test and CT load burden test definitions. Up to 10 test definitions can be stored per test plan, and up to 128 CT test plans can be stored in the EZCT-2000C's Flash EEPROM. The ability to use test plans makes CT testing an extremely simple process. To perform a test, the EZCT-2000C is connected to the CT terminals and a test plan is selected to run.

3.5.1. Extracting the Test Plan From a Test Record

A test plan can be extracted from a test record for immediate or future use. You can extract the test plan immediately after performing a test or you can extract the test plan from a restored test record (see section 3.4.1 for instructions on how to restore a test record). To extract a test plan from a test record:

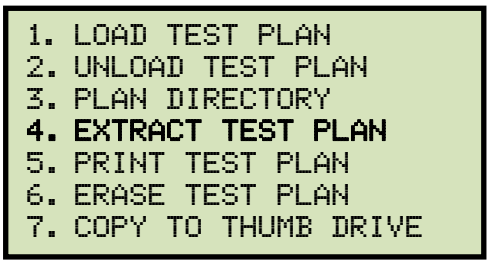
a. Either perform a test (see section 3.2) or recall a test record (see section 3.4.1) that you would like to extract the test plan from.

b. Start from the "START-UP" menu:



Press the **[3]** key (*TEST PLANS*).

c. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

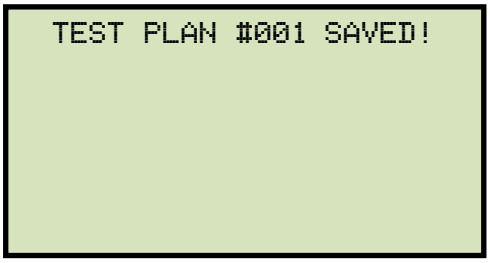
Press the **[4]** key (*EXTRACT TEST PLAN*)

NOTE

If there is no test record in the working memory, the following screen will be displayed:

Press any key to return to the "START-UP" menu.

d. The following screen will be displayed:



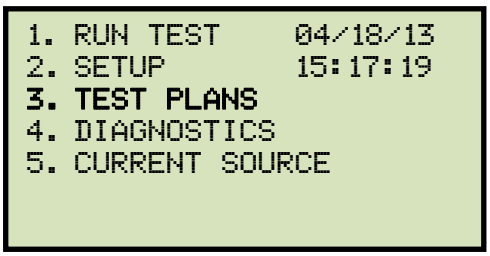
The test plan will be extracted from the test record in the working memory and will be saved to the EZCT-2000C's Flash EEPROM as a new test plan. The test plan number will be automatically incremented by the EZCT-2000C.

Press any key to return to the "START-UP" menu.

3.5.2. Printing a Directory of Test Plans Stored in the EZCT-2000C's Memory

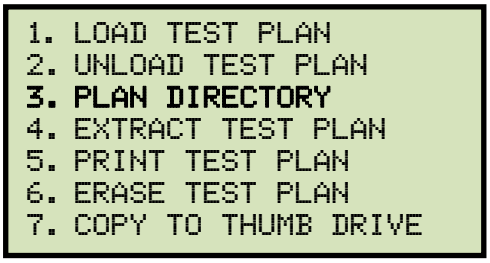
You can print a directory of all the test plans stored in the EZCT-2000C's Flash EEPROM using the steps below:

a. Start from the "START-UP" menu:



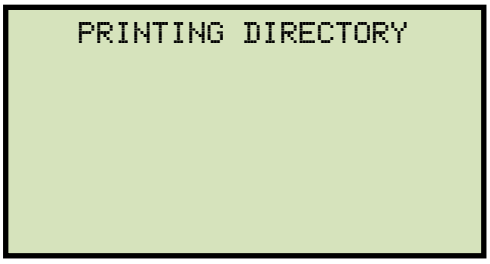
Press the **[3]** key (*TEST PLANS*).

b. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

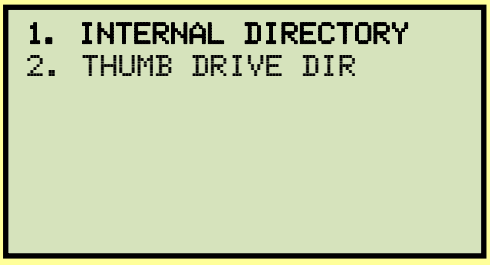
Press the **[3]** key (*PLAN DIRECTORY*).

c. The following screen will be displayed while the test plan directory is printed on the thermal printer:



NOTE

The above screen will be displayed only if a USB Flash drive is NOT connected to the EZCT-2000C's USB Flash drive port. If a USB Flash drive is connected, the following screen will be displayed:



Press the **[1]** key (*INTERNAL DIRECTORY*). Continue with the steps below:

You will be automatically returned to the "START-UP" menu after the directory printing is finished. A typical Flash EEPROM test plan directory printout is shown in Figure 20.

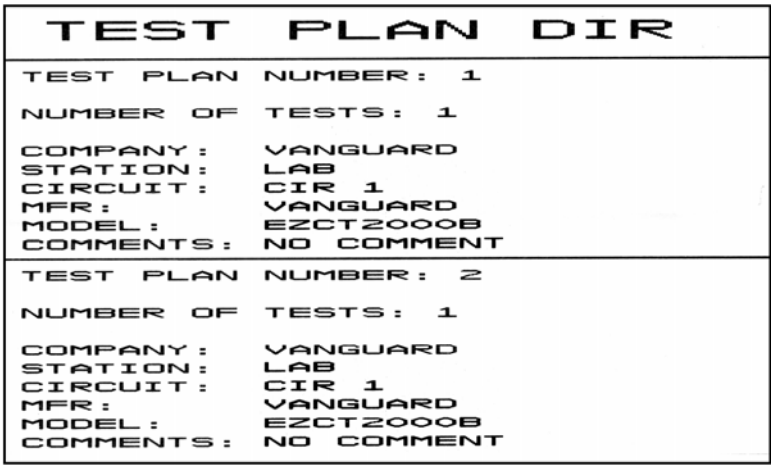
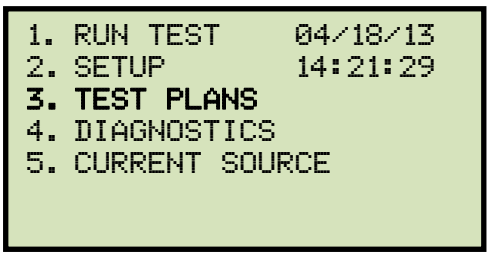


Figure 20. Typical EZCT-2000C Flash EEPROM Test Plan Directory Printout

3.5.3. Printing a Directory of Test Plans Stored in a USB Flash Drive

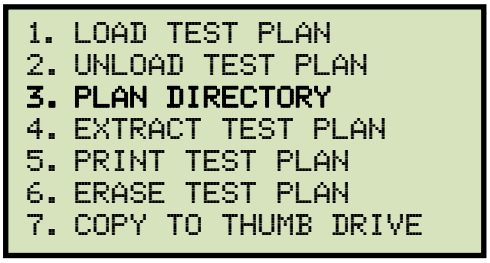
To print a directory of all the test plans stored in a USB Flash drive:

a. Make sure the USB Flash drive is inserted in the EZCT-2000C's USB Flash drive port ("USB MEM" port). Then start from the "START-UP" menu:



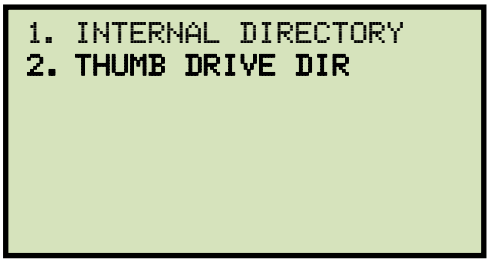
Press the **[3]** key (*TEST PLANS*).

b. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

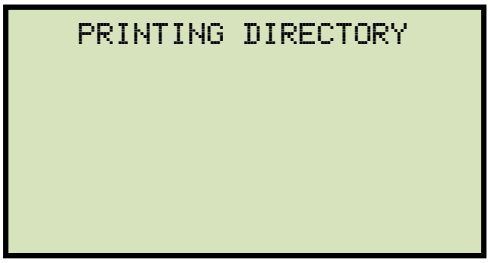
Press the **[3]** key (*PLAN DIRECTORY*).

c. The following screen will be displayed:



Press the **[2]** key (*THUMB DRIVE DIR*).

d. The following screen will be displayed while the test plan directory is being printed:



You will be returned to the "START-UP" menu once printing is finished. A typical USB Flash drive test plan directory printout is shown in Figure 21.

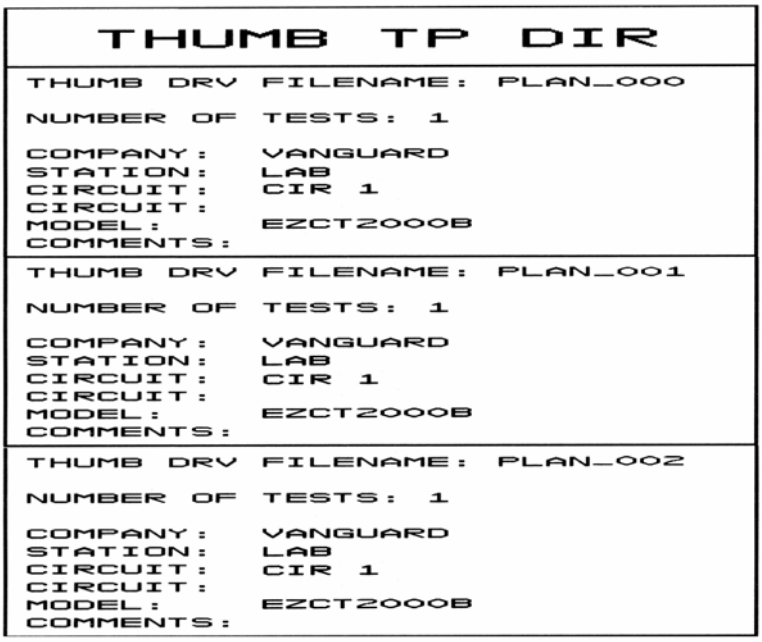
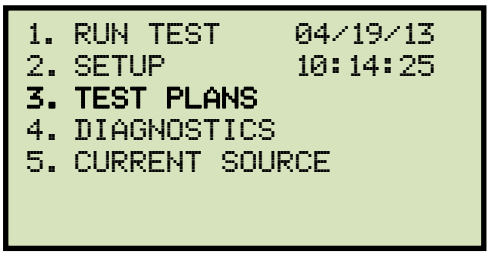


Figure 21. Typical USB Flash Drive Test Plan Directory Printout

3.5.4. Printing a Test Plan

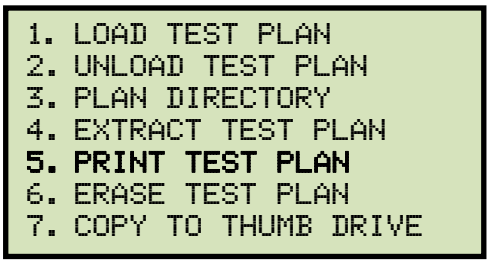
To print a test plan:

a. Start from the "START-UP" menu:



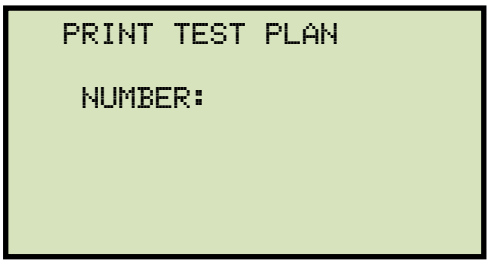
Press the **[3]** key (*TEST PLANS*).

b. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

Press the **[5]** key (*PRINT TEST PLAN*).

c. The following screen will be displayed:



Type the test plan number that you would like to print and press the **[ENTER]** key. If you do not know the test plan number, you can first print the test plan directory using the instructions in section 3.5.2.

The test plan will be printed on the thermal printer and you will be returned to the "START-UP" menu. A typical test plan printout is shown in Figure 22. Test plan elements are described in Table 5.

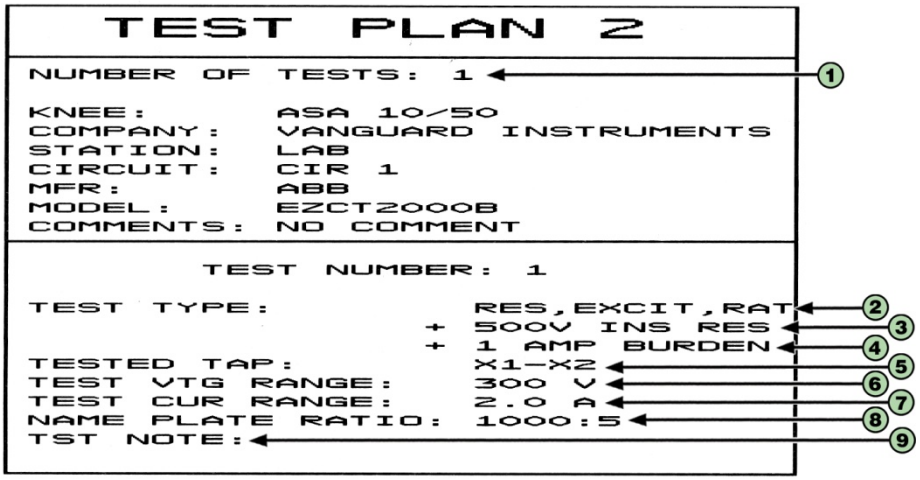


Figure 22. Typical Test Plan Printout

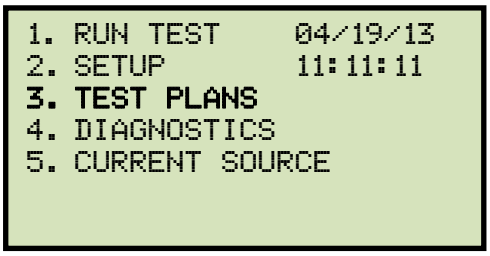
Table 5. Description of Test Plan Elements

Item Number	Description
1	Number of tests in test plan (1)
2	Tests to be performed (Resistance, excitation, turns ratio, insulation, and CT load burden)
3	Insulation test voltage (500 Vdc)
4	Injection current for load burden test (1 A)
5	Terminals used for excitation test (X1-X2)
6	Maximum excitation voltage (300 V)
7	Maximum excitation current (2.0 A)
8	CT nameplate ratio (1000:5)
9	Test notes (if any)

3.5.5. Erasing Test Plans From the Flash EEPROM

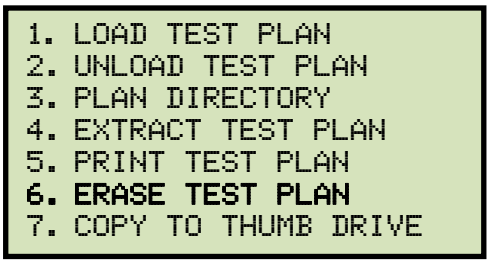
To erase one or all test plans from the EZCT-2000C's Flash EEPROM:

a. Start from the "START-UP" menu:



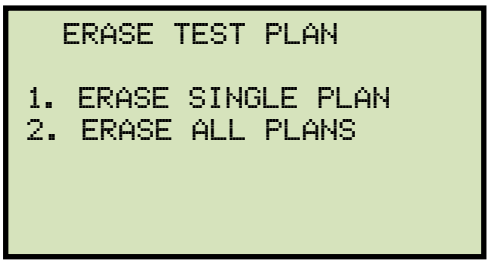
Press the **[3]** key (*TEST PLANS*).

b. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

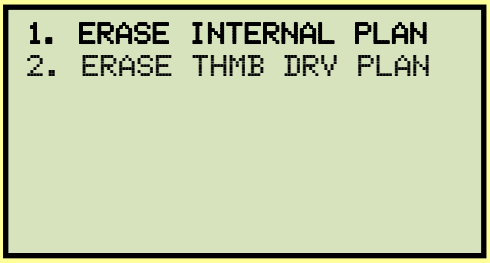
Press the **[6]** key (*ERASE TEST PLAN*).

c. The following screen will be displayed:



NOTE

The above screen will be displayed only if a USB Flash drive is NOT connected to the EZCT-2000C's USB Flash drive port. If a USB Flash drive is connected, the following screen will be displayed:



Press the **[1]** key (*ERASE INTERNAL PLAN*). The following screen will be displayed:

```
  ERASE TEST PLAN

1. ERASE SINGLE PLAN
2. ERASE ALL PLANS
```

Continue with the steps below:

1. *ERASE SINGLE PLAN*

   Press the **[1]** key if you would like to erase a single test plan. The following screen will be displayed:

```
  ERASE TEST PLAN

    NUMBER:
```

   Type the test plan number that you would like to erase and press the **[ENTER]** key.

NOTES

- You can press the **[STOP]** key to cancel the process.
- If you do not know the test plan number, you can print a test plan directory using the instructions in section 3.5.2.

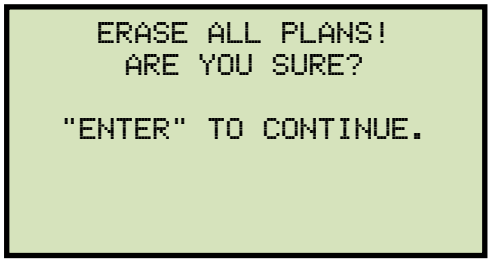
   The selected test plan will be erased and the following screen will be displayed:

```
TEST PLAN NUMBER 1
  ERASED!
```

   Press any key to return to the "START-UP" menu.

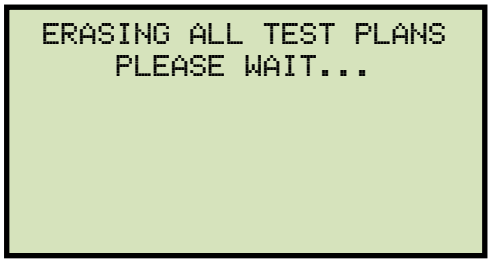
2. *ERASE ALL PLANS*

   Press the **[2]** key if you would like to erase all test plans. The following screen will be displayed:

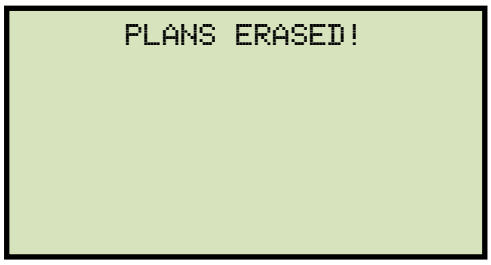


If you would like to cancel the erasure process, press the **[STOP]** key. No test plans will be erased and you will be returned to the "START-UP" menu.

Press the **[ENTER]** key to continue with the erasure process. The following screen will be displayed while the test plans are being erased:



The following screen will be displayed after all of the test plans have been erased:

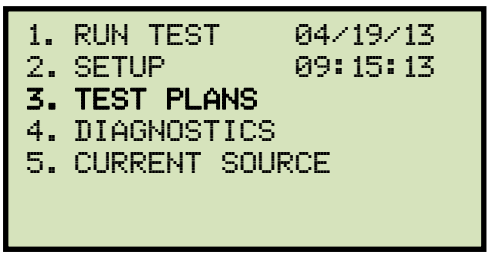


Press any key return to the "START-UP" menu.

3.5.6. Erasing Test Plans From a USB Flash Drive

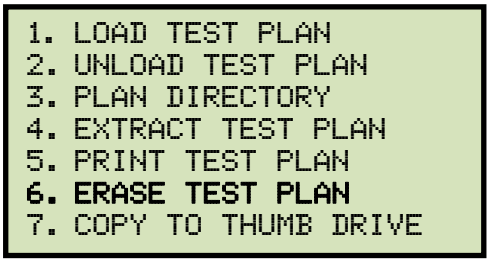
To erase one or all test plans stored on a USB Flash drive:

a. Make sure the USB Flash drive is inserted in the EZCT-2000C's USB Flash drive port ("USB MEM" port). Then start from the "START-UP" menu:



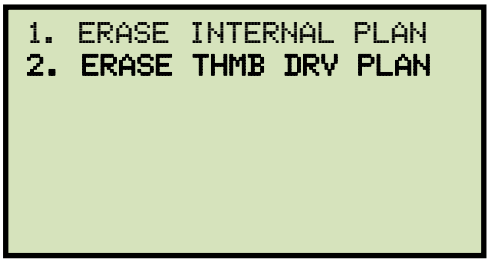
Press the **[3]** key (*TEST PLANS*).

b. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

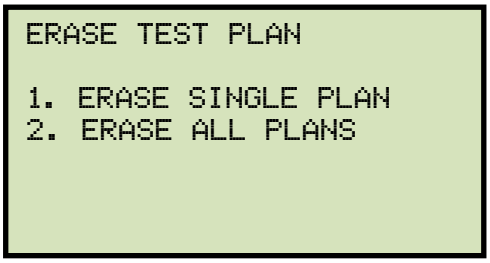
Press the **[6]** key (*ERASE TEST PLAN*).

c. The following screen will be displayed:



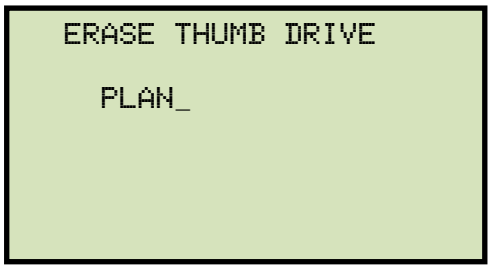
Press the **[2]** key (*ERASE THMB DRV PLAN*).

d. The following screen will be displayed:



1. *ERASE SINGLE PLAN*

Press the **[1]** key (*ERASE SINGLE PLAN*) if you would like to erase a single plan from the USB Flash drive. The following screen will be displayed:

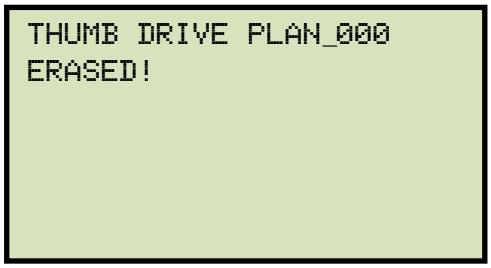


Type the test plan number that you would like to erase and press the **[ENTER]** key.

NOTES

- You can press the **[STOP]** key to cancel the process.
- If you do not know the test plan number, you can print a test plan directory using the instructions in section 3.5.3.

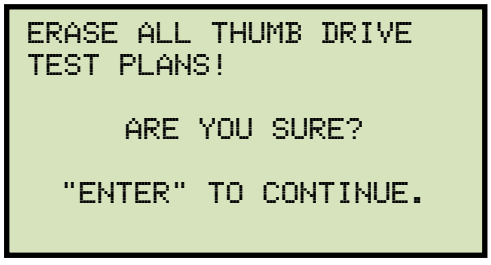
The selected test plan will be erased and the following screen will be displayed:



Press any key to return to the "START-UP" menu.

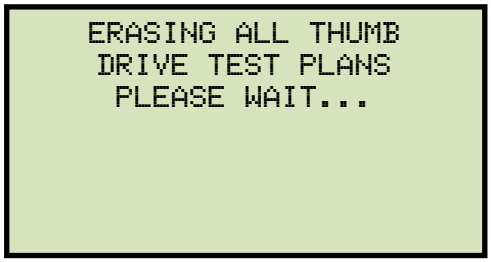
2. *ERASE ALL PLANS*

Press the [2] key (ERASE ALL PLANS) if you would like to erase all the test plans on the USB Flash drive. The following screen will be displayed:

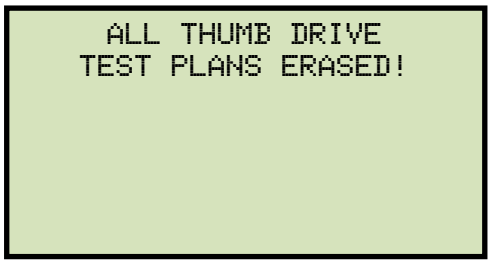


If you would like to cancel the erasure process, press the [STOP] key. No test plans will be erased and you will be returned to the "START-UP" menu.

Press the [ENTER] key to continue with the erasure process. The following screen will be displayed while the test plans are being erased:



The following screen will be displayed after all of the test plans have been erased from the USB Flash drive:

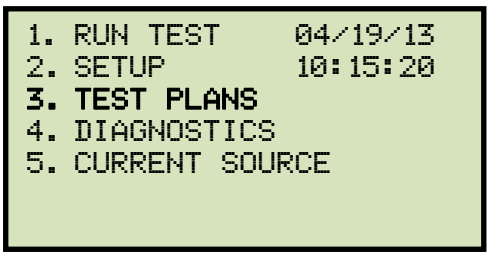


Press any key to return to the "START-UP" menu.

3.5.7. Loading a Test Plan from the EZCT-2000C's Flash EEPROM

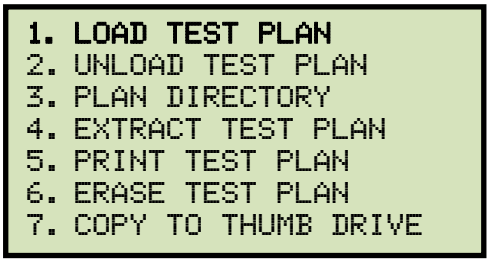
To use a test plan for running a test, it must first be loaded into the working memory. To load a test plan from the EZCT-2000C's Flash EEPROM into the working memory:

a. Start from the "START-UP" menu:



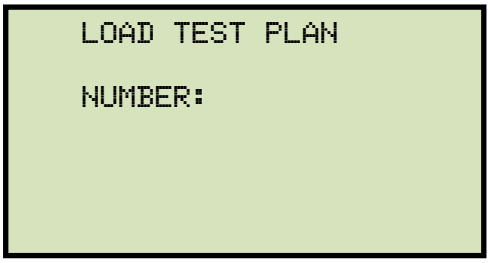
Press the **[3]** key (*TEST PLANS*).

b. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

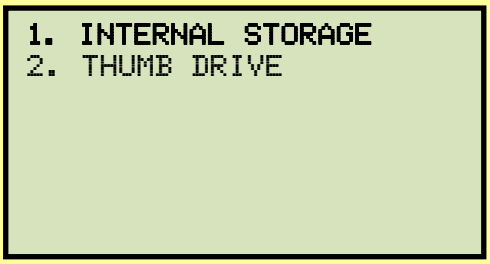
Press the **[1]** key (*LOAD TEST PLAN*).

c. The following screen will be displayed:

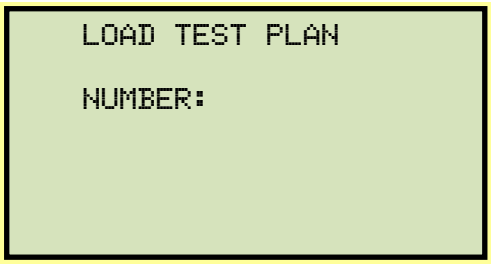


NOTE

The above screen will be displayed only if a USB Flash drive is NOT connected to the EZCT-2000C's USB Flash drive port. If a USB Flash drive is connected, the following screen will be displayed:



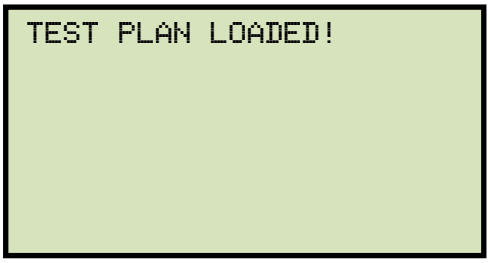
Press the **[1]** key (*INTERNAL STORAGE*). The following screen will be displayed:



Continue with the steps below:

Type the test plan number that you would like to load and press the **[ENTER]** key. If you do not know the test plan number, you can print a test plan directory using the instructions in section 3.5.2.

d. The following screen will be displayed:

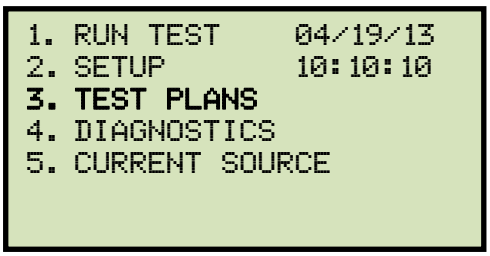


Press any key to return to the "START-UP" menu.

3.5.8. Loading a Test Plan from a USB Flash Drive

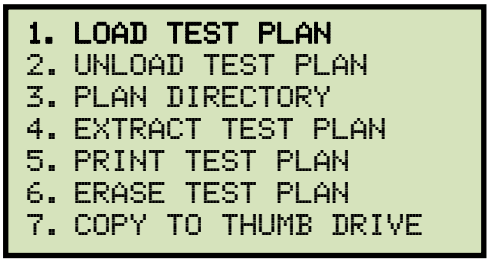
To load a test plan from a USB Flash drive:

a. Make sure the USB Flash drive is inserted in the EZCT-2000C's USB Flash drive port ("USB MEM" port). Then start from the "START-UP" menu:



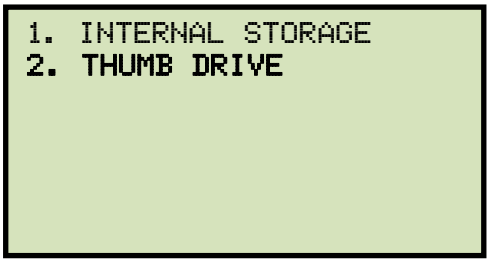
Press the **[3]** key (*TEST PLANS*).

b. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

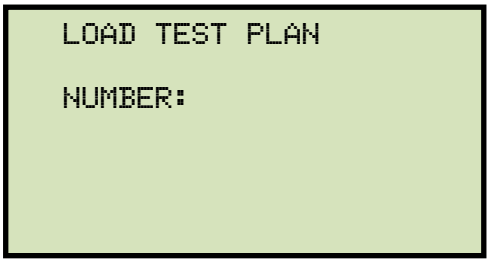
Press the **[1]** key (*LOAD TEST PLAN*).

c. The following screen will be displayed:



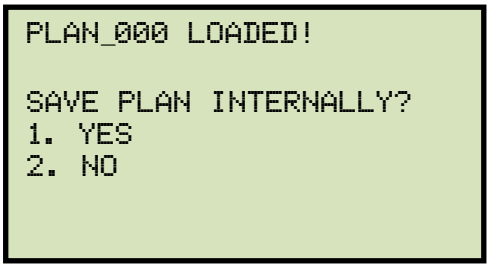
Press the **[2]** key (*THUMB DRIVE*).

d. The following screen will be displayed:



Type the test plan number that you would like to load and press the **[ENTER]** key. If you do not know the test plan number, you can print a test plan directory using the instructions in section 3.5.3.

e. The following screen will be displayed:



1. *YES*

   Press the **[1]** key if you would like the loaded test plan to be also saved in the EZCT-2000C's Flash EEPROM. Any existing test plans in the EZCT-2000C's Flash EEPROM will not be over-written. The EZCT-2000C will automatically assign a new test plan number and store the test plan in the next available memory location. The following screen will be displayed:

   Press any key to return to the "START-UP" menu.

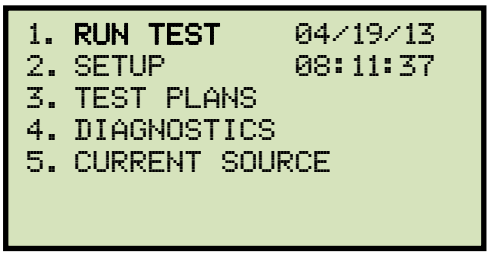
2. *NO*

   Press the **[2]** key if you do not want to save the loaded test plan in the EZCT-2000C's Flash EEPROM. It will be loaded into the working memory, and you will be returned to the "START-UP" menu.

3.5.9. Running a Test Using a Loaded Test Plan

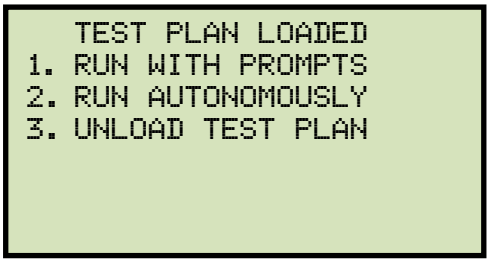
Once a test plan has been loaded into the working memory (see section 3.5.6 for directions), it can be used to run a test. To run a test using a loaded test plan:

a. Make sure a test plan has been loaded into the working memory and then start from the "START-UP" menu:



Press the **[1]** key (*RUN TEST*).

b. The following screen will be displayed (this screen will only be displayed if a test plan has been loaded first):

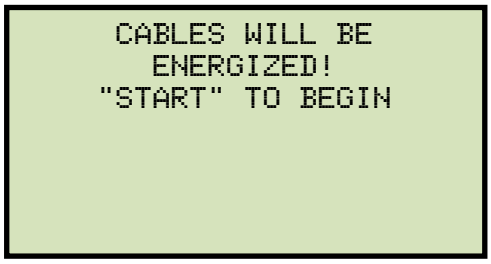


1. *RUN WITH PROMPTS*

   Press the **[1]** key to run the test with prompts. Continue to step c.

2. *RUN AUTONOMOUSLY*

   Press the **[2]** key to run the test autonomously. The following screen will be displayed:

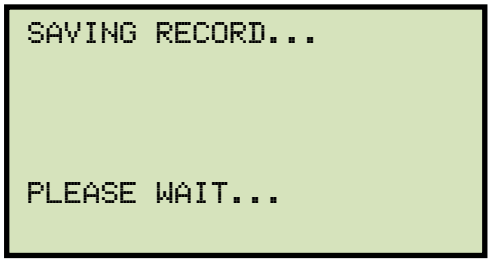


   Press the **[START]** key and the EZCT-2000C will start running the test per the test plan settings. The screen will be updated with the test status.

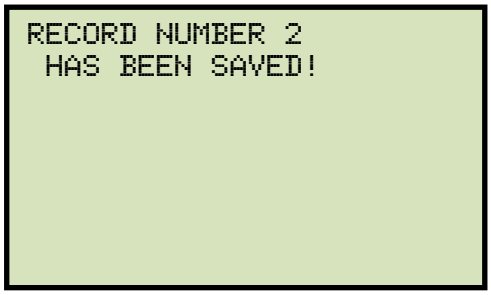
When the test has finished, the following screen will be displayed:

Press the **[1]** key (*YES*) to save the record.

The following screen will be displayed momentarily:



Then the following confirmation screen will be displayed:

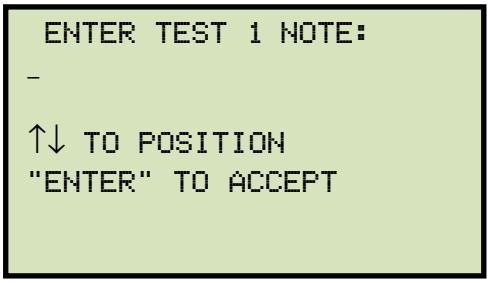


Press any key to return to the "START-UP" menu.

3. *UNLOAD TEST PLAN*

Press the **[3]** key to unload the test plan and run a test without a test plan. This will unload the test plan from the working memory and bring up the standard "RUN TEST" menu. Please see section 3.3.2, step b.

c. The following screen will be displayed:

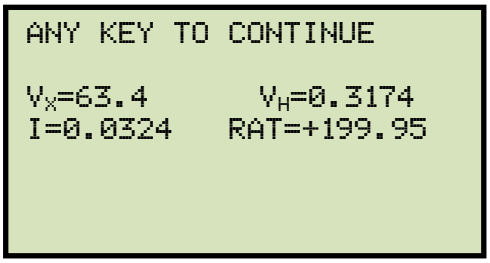


Use the keypad to enter a test note and press the **[ENTER]** key.

d. The following confirmation screen will be displayed showing the test parameters (the screen will vary depending on which test is being performed as defined in the test plan):

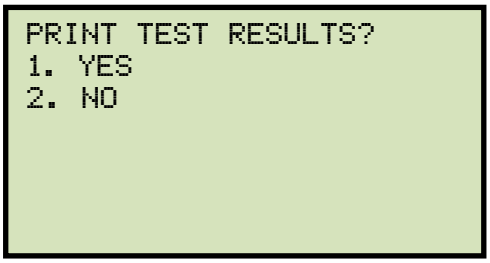
Press the **[START]** key to begin the test.

e. The EZCT-2000C will start performing the test per the test plan parameters. When the test has finished, the following screen will be displayed:



Press any key to continue.

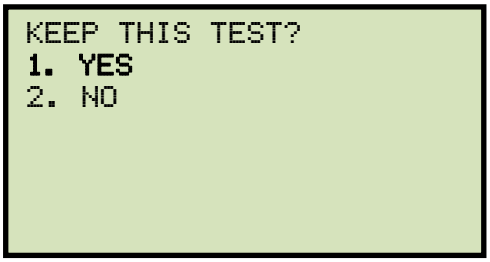
f. The following screen will be displayed:



Press the **[1]** key (*YES*) if you would like to print the test results.

Press the **[2]** key (*NO*) if you do not want to print the test results.

g. The following screen will be displayed:

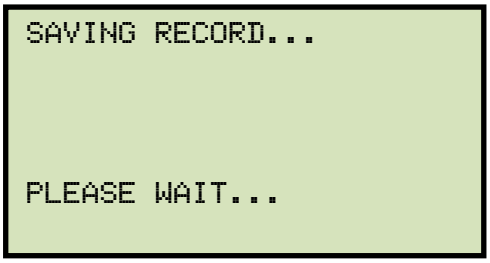


Press the **[1]** key (*YES*) to keep the test results.

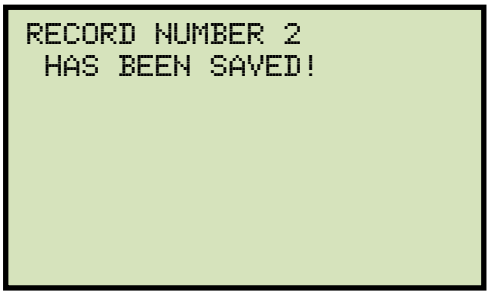
h. The following screen will be displayed:

Press the **[1]** key (*YES*) to save the record.

The following screen will be displayed momentarily:



The following confirmation screen will then be displayed:

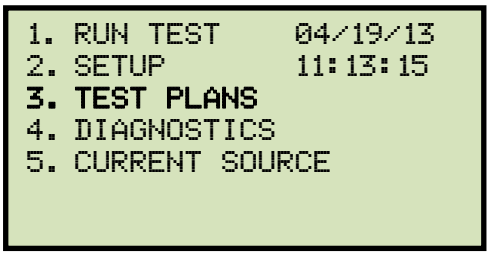


Press any key to return to the "START-UP" menu.

3.5.10. Unloading a Test Plan from the Working Memory

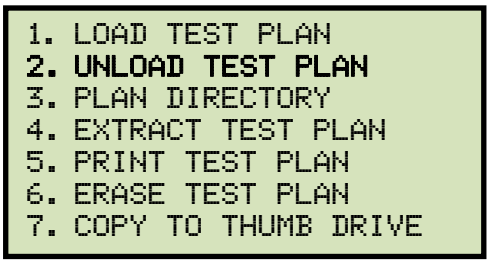
To unload the test plan from the working memory and clear all the test plan parameters:

a. Start from the "START-UP" menu:



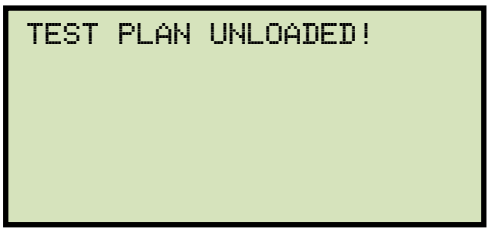
Press the **[3]** key (*TEST PLANS*).

b. The following screen will be displayed:


1. LOAD TEST PLAN
2. UNLOAD TEST PLAN
3. PLAN DIRECTORY
4. EXTRACT TEST PLAN
5. PRINT TEST PLAN
6. ERASE TEST PLAN
7. COPY TO THUMB DRIVE

Press the **[2]** key (*UNLOAD TEST PLAN*).

c. The following screen will be displayed:



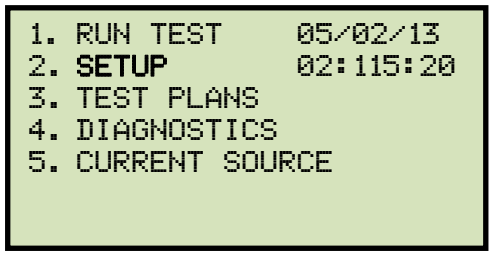
Press any key to return to the "START-UP" menu.

4.0 CHANGING SETUP PARAMETERS

4.1 Setting the Knee Point Marker

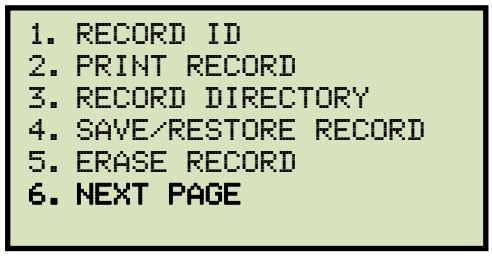
Use the steps below to change the knee point marker for the excitation graph:

a. Start from the "START-UP" menu:



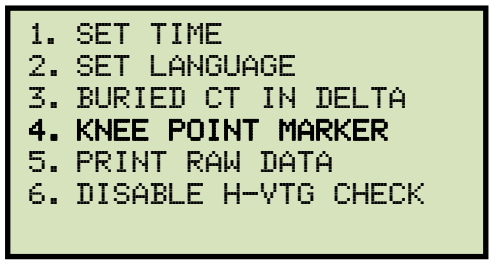
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



Press the **[6]** key (*NEXT PAGE*).

c. The following screen will be displayed:



Press the **[4]** key (*KNEE POINT MARKER*)

d. The following screen will be displayed:

```
1. IEEE 30 DEGREE
2. IEEE 45 DEGREE
3. IEC 10%V --> 50%I
```

Press either the **[1]** key (*IEEE 30 DEGREE*), the **[2]** key (*IEEE 45 DEGREE*), or the **[3]** key (*IEC 10%V --> 50%I*) to select the desired knee point marker. The knee point marker will be set and you will be returned to the "START-UP" menu. A graphic report showing the knee point marker is shown in Figure 23.

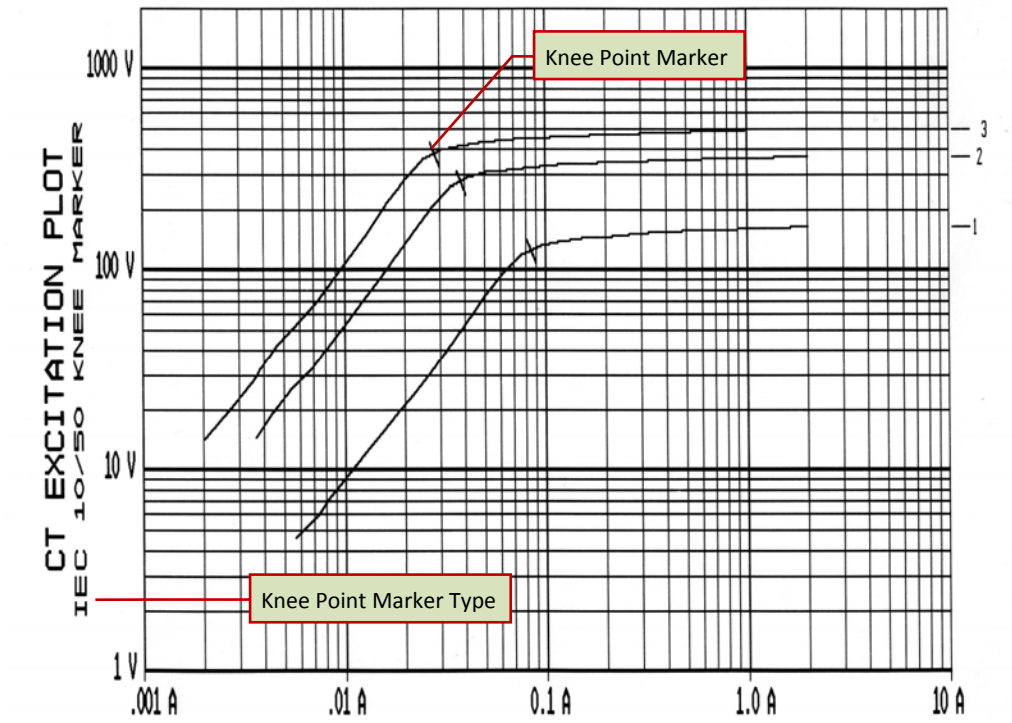


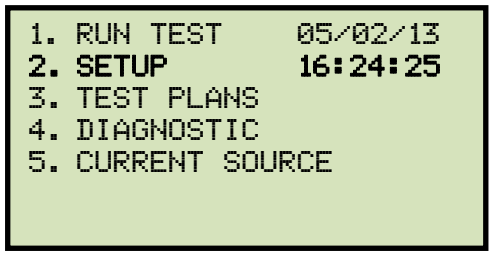
Figure 23. Graphic Report Showing Knee Point Marker

4.2 Enabling and Disabling the Buried CT in Transformer Delta Option

4.2.1. Enabling the Buried CT in Transformer Delta Option

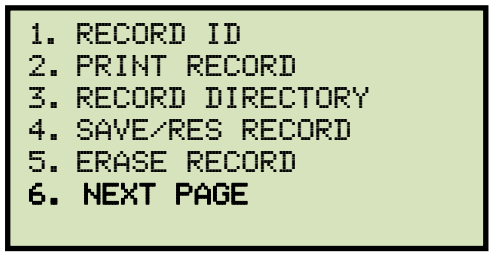
If you are measuring the turns ratio of a CT buried in the transformer Delta windings (see Figure 24 and Figure 25 and also page 94 for further information), you must first select the "Buried CT in Delta" option from the "SETUP" menu using the steps below:

a. Start from the "START-UP" menu:



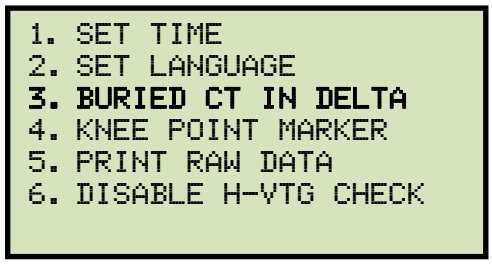
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



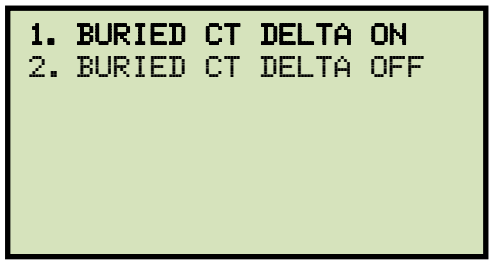
Press the **[6]** key (*NEXT PAGE*).

c. The following screen will be displayed:



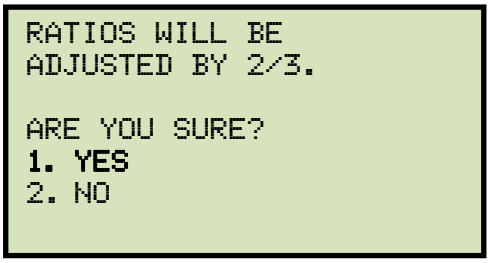
Press the **[3]** key (*BURIED CT IN DELTA*).

d. The following screen will be displayed:



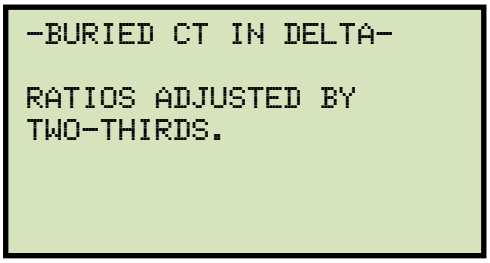
Press the **[1]** key (*BURIED CT DELTA ON*).

e. The following screen will be displayed:



Press the **[1]** key (*YES).*

f. The following screen will be displayed:

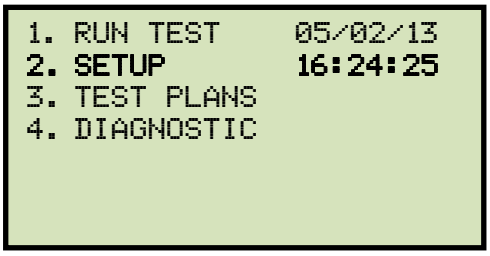


Press any key to return to the "START-UP" menu.

4.2.2. Disabling the Buried CT in Transformer Delta Option

To disable the Buried CT in Transformer Delta Option:

a. Start from the "START-UP" menu:

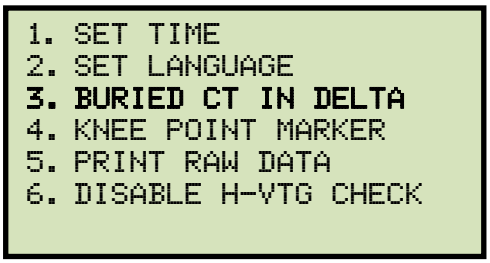


Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:

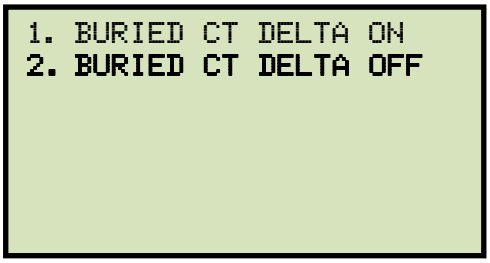
Press the **[6]** key (*NEXT PAGE*).

c. The following screen will be displayed:



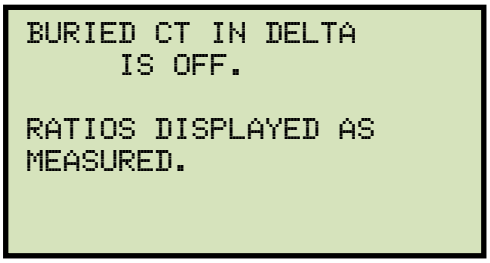
Press the **[3]** key (*BURIED CT IN DELTA*).

d. The following screen will be displayed:



Press the **[2]** key (*BURIED CT DELTA OFF*).

e. The following screen will be displayed:



Press any key to return to the "START-UP" menu.

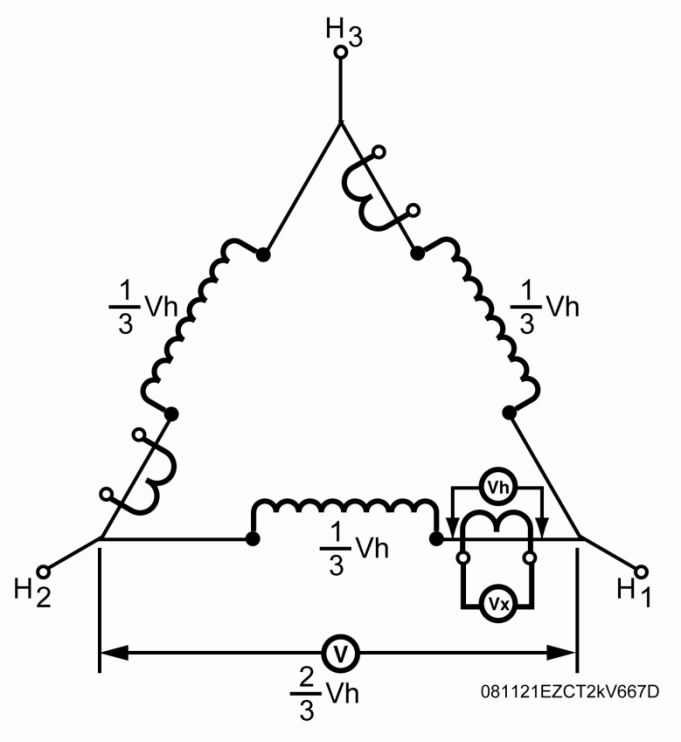


Figure 24. Buried CT in a Delta Transformer Illustration 1

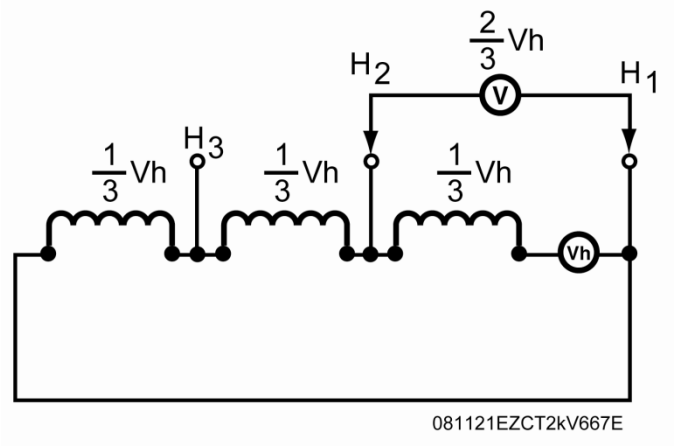


Figure 25. Buried CT in a Delta Transformer Illustration 2

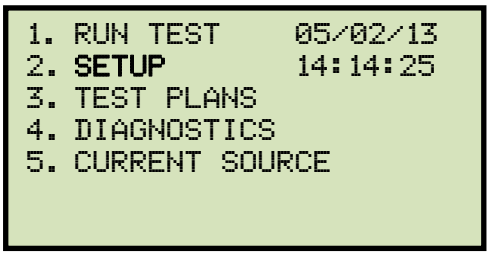
NOTES

- The CT turns ratio is ideally measured as: $\text{Ratio} = \frac{Vx}{Vh}$.
- Since the induced voltage (V) is sensed through the H1-H2 terminals of the Delta winding, this induced voltage is measured as $V = (\frac{2}{3})\ Vh$.
- The CT turns ratio is now measured as $\text{Ratio} = \frac{Vx}{V}$ or $\text{Ratio} = (\frac{3}{2})(\frac{Vx}{Vh})$. This measured turns ratio is $\frac{3}{2}$ higher than the actual turns ratio.
- The EZCT-2000C will display the correct CT turns ratio by adjusting the measured turns ratio by $\frac{2}{3}$.

4.3 Setting the Clock

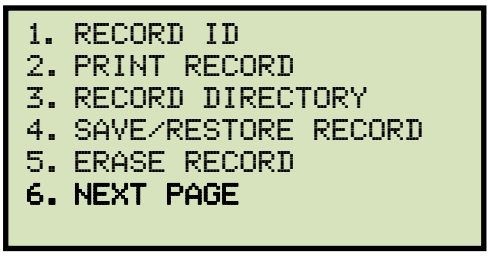
To set the EZCT-2000C's internal clock:

a. Start from the "START-UP" menu:



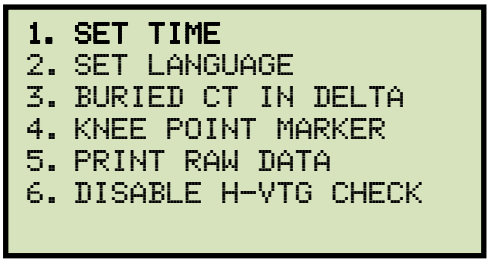
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



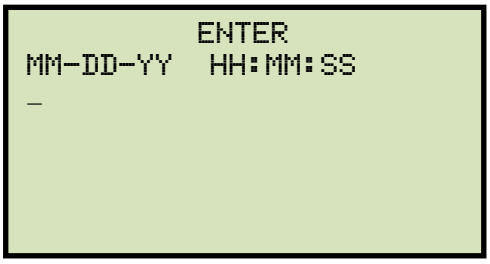
Press the **[6]** key (*NEXT PAGE*).

c. The following screen will be displayed:



Press the **[1]** key (*SET TIME*).

d. The following screen will be displayed:

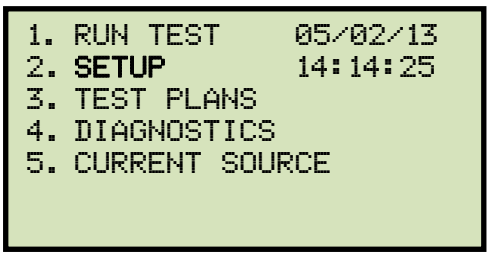


Enter the month, date, time, hours, minutes, and seconds (in 24-hour format) using the keypad. When the last digit is entered, the clock will be set and you will be returned to the "START-UP" menu.

4.4 Setting the Preferred Interface Language

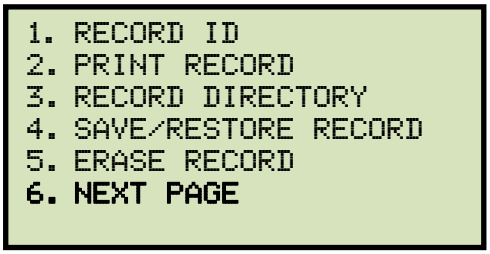
Follow the steps below to set the preferred language for the EZCT-2000C's interface (English, Spanish, and Turkish are supported):

a. Start from the "START-UP" menu:



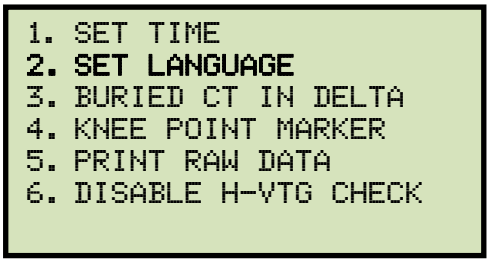
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



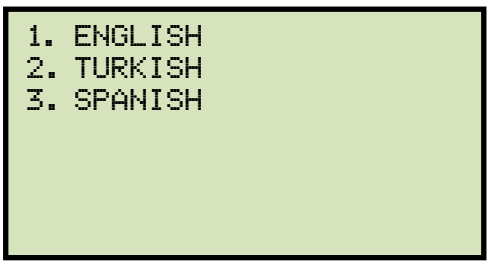
Press the **[6]** key (*NEXT PAGE*).

c. The following screen will be displayed:



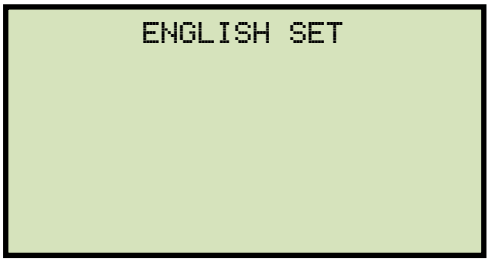
Press the **[2]** key (*SET LANGUAGE*).

d. The following screen will be displayed:



Select the preferred language by pressing the corresponding number on the keypad.

e. A confirmation message will be displayed as shown below:

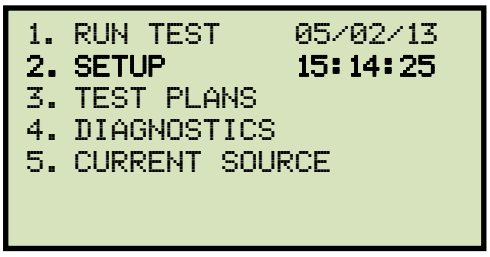


Press any key to return to the "START-UP" menu. Menu items and messages will now be displayed in the selected language.

4.5 Printing Raw Memory Buffer Data

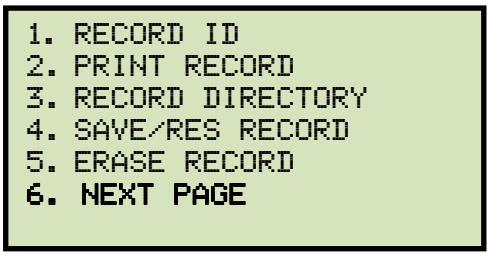
You can print the raw data from the EZCT-2000C's memory buffer for diagnostic purposes. This will print a table of current and voltage values stored in the unit's working memory. To print the raw buffer data:

a. Start from the "START-UP" menu:



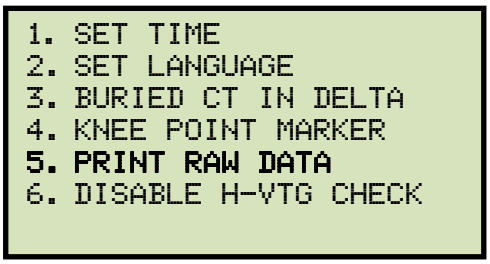
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



Press the **[6]** key (*NEXT PAGE*).

c. The following screen will be displayed:



Press the **[5]** key (*PRINT RAW DATA*). The raw buffer data will be printed and you will be returned to the "START-UP" menu.

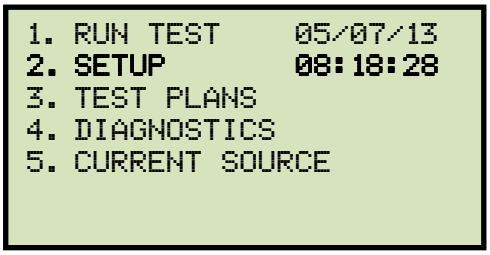
4.6 Disabling the H Voltage Checking Feature

The EZCT-2000C's H Voltage input can only handle voltage up to 100 Vac. When a saturation test is being performed, the unit monitors the H voltage and stops the saturation test if a voltage above 100 Vac is detected. In certain noisy substation environments, the unit may pick up a noise spike which may be interpreted as high voltage input to the H terminal, causing the unit to stop the saturation test. For such cases, it may be necessary to disable the H Voltage monitoring feature so that a saturation test can be properly completed. Follow the steps below to disable the H Voltage checking features:

WARNING

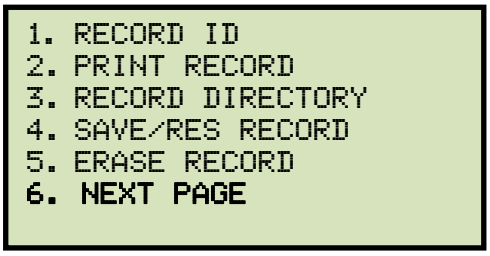
If this feature is disabled and an actual over-voltage situation exists (voltage over 100 Vac), it will NOT be detected by the EZCT-2000C and can cause damage to the unit. This feature should be disabled only after confirming that an actual over-voltage situation does not exist.

a. Start from the "START-UP" menu:



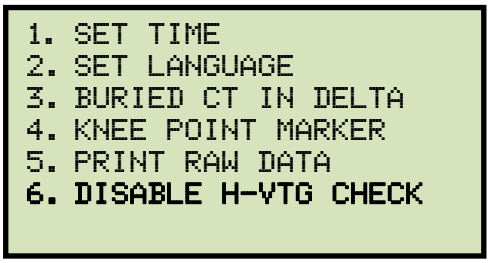
Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:



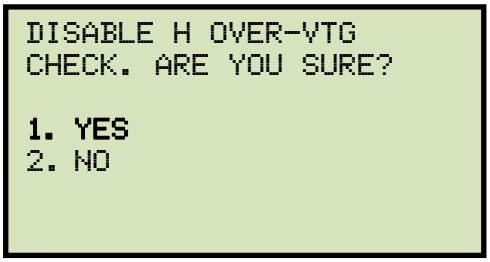
Press the **[6]** key (*NEXT PAGE*).

c. The following screen will be displayed:



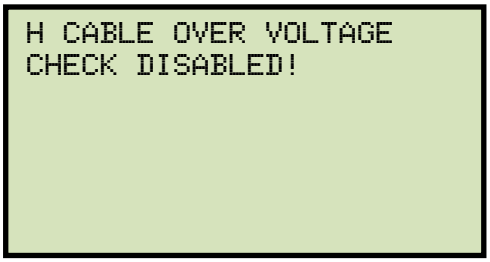
Press the **[6]** key (*DISABLE H-VTG CHECK*).

d. The following screen will be displayed:



Press the **[1]** key (*YES*).

e. The following confirmation screen will be displayed:



Press any key to return to the "START-UP" menu.

To re-enable the H Voltage checking feature, follow the steps above but select option **[2]** in step d.

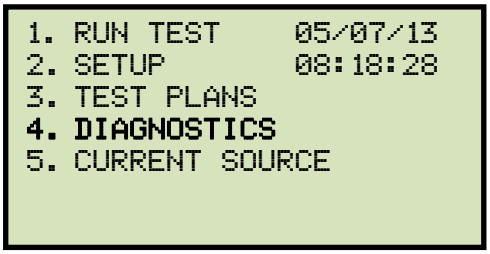
5.0 DIAGNOSTICS, VERIFICATION, AND TROUBLESHOOTING

5.1 Performing a Diagnostics Test

The Diagnostics test mode displays the output voltage at the selected X leads (V_x), the voltage sensed by the H leads (V_h), and the X voltage excitation current (I_x). These values can then be verified using an external volt meter and ampere meter.

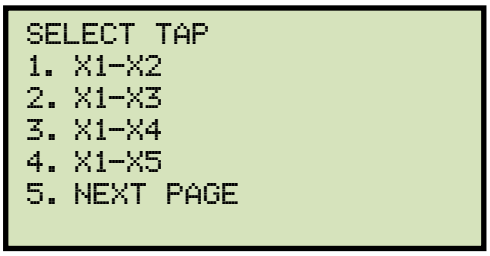
To perform a diagnostic test:

a. Start from the "START-UP" menu:



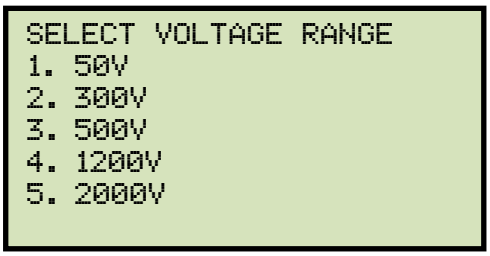
Press the **[4]** key (*DIAGNOSTICS*).

b. The following screen will be displayed:



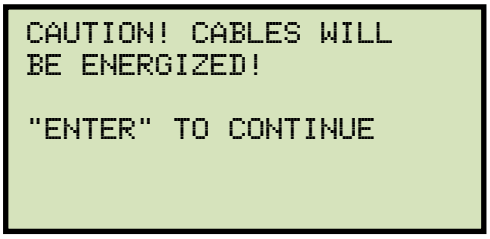
Select the tap connection by pressing the corresponding key (**[1]** – **[4]**). If the tap connection is not listed, press the **[5]** key to view the next page of options and then select the correct tap connection.

c. The following screen will be displayed:



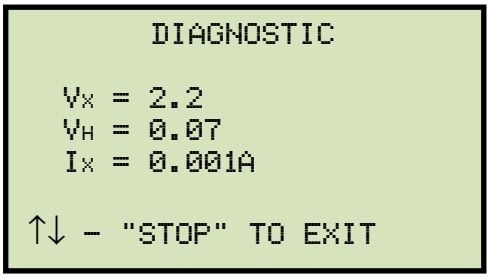
Select the maximum output voltage on the X terminals by pressing the corresponding key (**[1]** – **[5]**).

d. The following screen will be displayed:



Press the **[ENTER]** key to continue.

e. The following screen will be displayed and the V_x, V_h, and I_x values will be continuously updated for 15 seconds:



You can press the **[∧]** or **[∨]** key to increase or decrease the V_x voltage, respectively. You can press the **[STOP]** key to end the test immediately and return to the "START-UP" menu.

The test will automatically end after 15 seconds, and you will be returned to the "START-UP" menu.

5.2 Verifying the EZCT-2000C's V_x Sense Circuit Using an External Meter

The excitation voltage (V_x) sensed by the EZCT-2000C can be verified using an external RMS volt meter. Follow the steps below to verify the EZCT-2000C's V_x sense circuit:

a. Connect the X cables to an RMS volt meter as shown in Figure 26.

b. Select the EZCT-2000C's Diagnostics mode (see section 5.1).

c. Press the **[∧]** key to raise the V_x voltage.

d. Verify the V_x voltage displayed on the EZCT-2000C LCD screen against the value displayed on the external volt meter.

e. Press the **[STOP]** key to end the test.

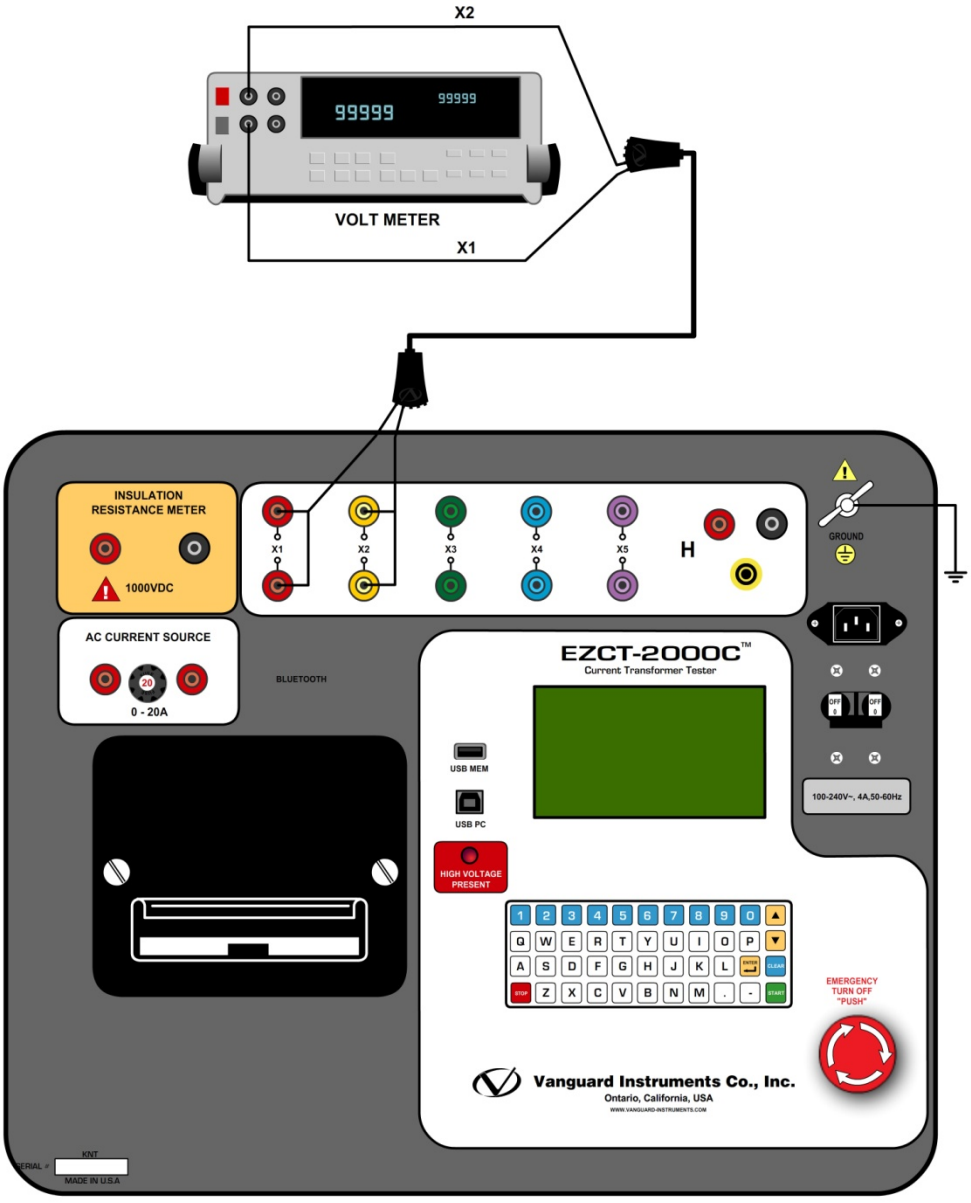


Figure 26. EZCT-2000C V_x Verification Test Connections

5.3 Verifying the EZCT-2000C's I_x Sense Circuit Using an External Meter

You can verify the excitation current (I_x) sensed by the EZCT-2000C by using an external RMS ampere meter. Follow the steps below to verify the EZCT-2000C's I_x sense circuit:

a. Connect the X cables to a power resistor and an RMS ampere meter as shown in Figure 27.

b. Select the EZCT-2000C's Diagnostics mode (see section 5.1).

c. Press the **[∧]** key to raise the V_x voltage.

d. Verify the I_x voltage displayed on the EZCT-2000C's LCD screen against the value displayed on the external RMS ampere meter.

e. Press the **[STOP]** key to end the test.

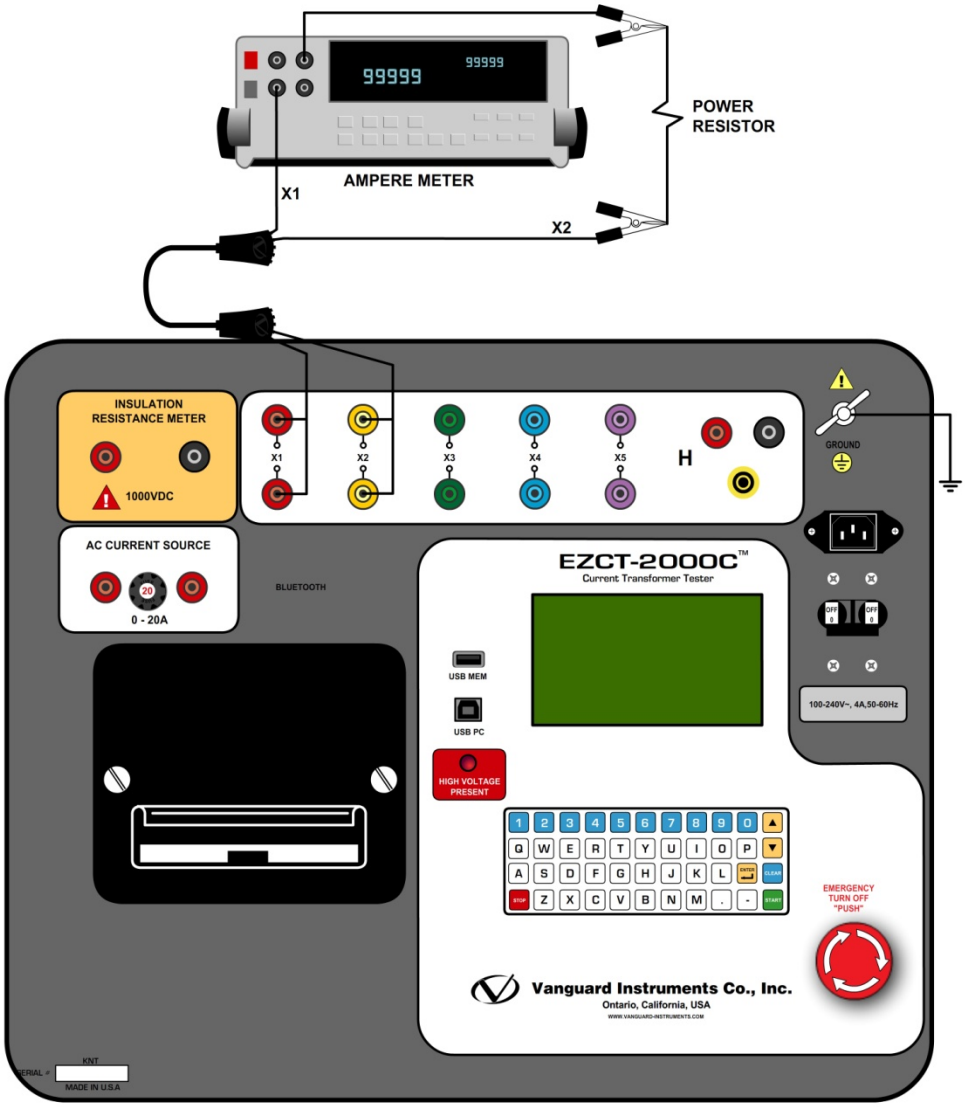


Figure 27. EZCT-2000C I_x Verification Test Connections

5.4 Quickly Verifying the EZCT-2000C's Turns Ratio Circuit

You can quickly verify the EZCT-2000C's turns ratio circuit by performing the following ratio test:

a. Connect the X1 test lead to the H1 test lead as shown in Figure 28.

b. Connect the X2 test lead to the H2 test lead as shown in Figure 28.

c. Run a turns ratio test (see section 3.3.2).

d. Observe the turns ratio test on the LCD screen. The turns ratio should be 1.000 since the excitation voltage is the same as the sensed voltage.

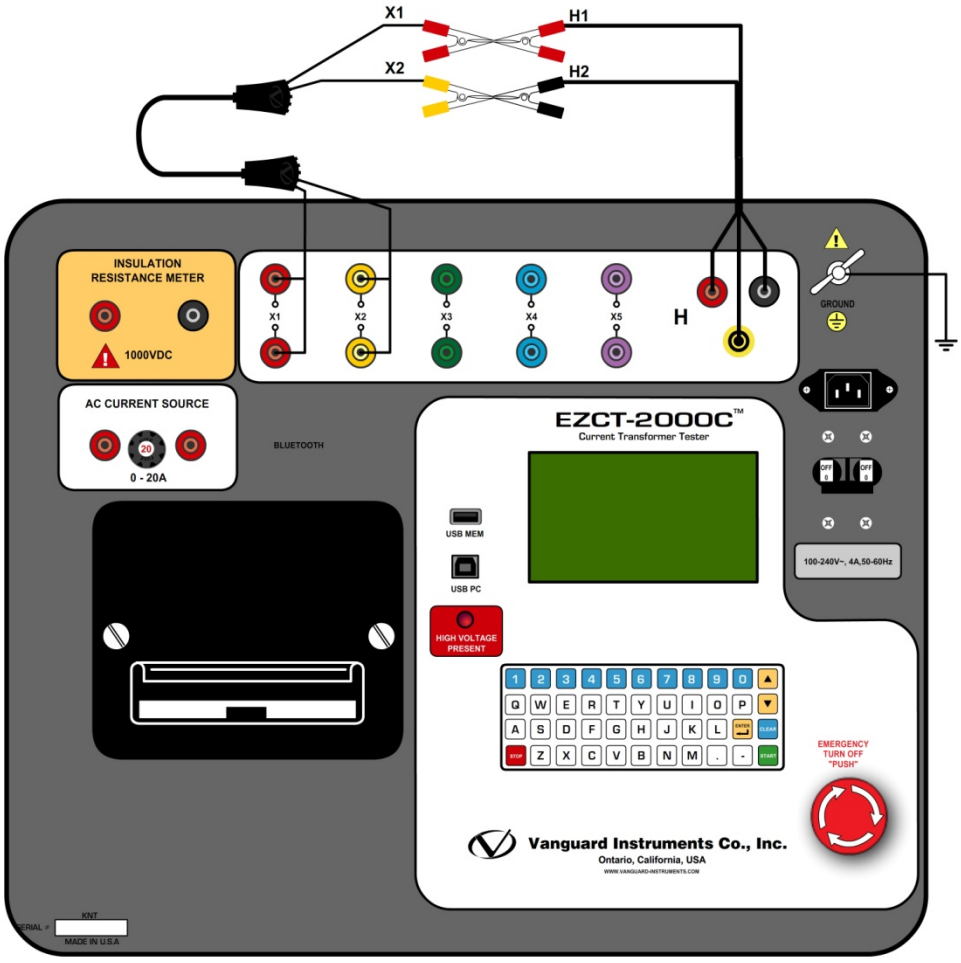


Figure 28. EZCT-2000C Turns Ratio Verification Test Connections

5.5 Troubleshooting Guide

PROBLEM DESCRIPTION	Probable Cause	Suggested Solution
When running the excitation test, the V_x voltage is always zero. The excitation current can be raised during a test.	• The EZCT-2000C X cables are driving a short circuit.	• Check CT shorting screws. • Check X lead connections.
When running the excitation test, the V_x voltage can be raised but the excitation current is always zero during a test.	• The EZCT-2000C X cable is driving an opened circuit.	• Check the CT terminal connection.
CT excitation knee point voltages and turns ratio readings are incorrect.	• CT may not be completely de-magnetized. • If the user runs a dc resistance test, the CT will be magnetized. The next test the EZCT-2000C executes is an excitation test. If the excitation current did not reach at least 0.8A, the CT is not completely de-magnetized.	• Raise the excitation voltage setting in the test plan. • Re-run the excitation test. • You can quickly verify if the CT was de-magnetized by looking at the last excitation graph.
When running the excitation test, the V_x reading is erratic.	• The EZCT-2000C X cable may be opened. Each X cable has two conductors going from the clip end to the banana jacks. If one of the conductors is opened, the V_x readings will be erratic.	• Remove X cables from the EZCT-2000C and the CT terminals. • Check cable integrity using an Ohm Meter.
Saturation test is correct but turns ratio test is erroneous.	• V_H cables problem.	• Check the V_H cable connection. • Check the V_H cable integrity with an Ohmmeter
Turns ratio test of a CT mounted on a transformer bushing is incorrect.	• Transformer windings opposite side of CT windings is not shorted.	• See Figure 9.

6.0 Appendix A - Calculating Turns Ratio on a Shunt Reactor

The Vanguard EZCT line of products use the voltage method to measure the turns-ratio on current transformers. A typical connection for a stand-alone CT is shown in Figure 29.

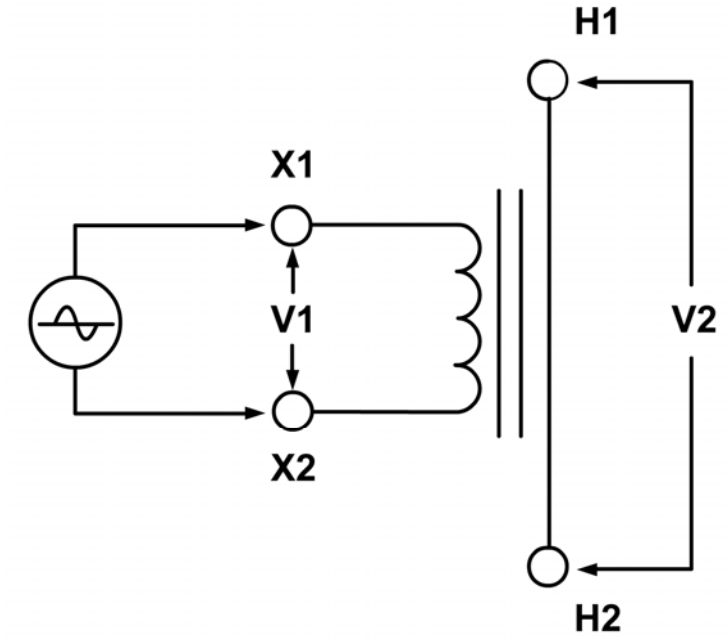


Figure 29

The EZCT applies a test voltage (V1) to the CT secondary winding. The induced voltage (V2) is sensed through the CT primary winding. In this case a single conductor is used. By definition, the turns-ratio is the voltage ratio:

$$\text{Ratio}=\frac{V1}{V2}$$

Figure 30 shows a typical connection of a CT mounted on the primary bushing of a single phase transformer. When the voltage V1 is introduced to the CT's secondary winding, there is an induced voltage (V3) on the primary winding of this single phase transformer. Since the only access to the transformer is between terminals H1-H0, The V3 voltage will be included and the turns-ratio will be:

$$\textbf{Ratio}=\frac{V1}{(V2+V3)}$$

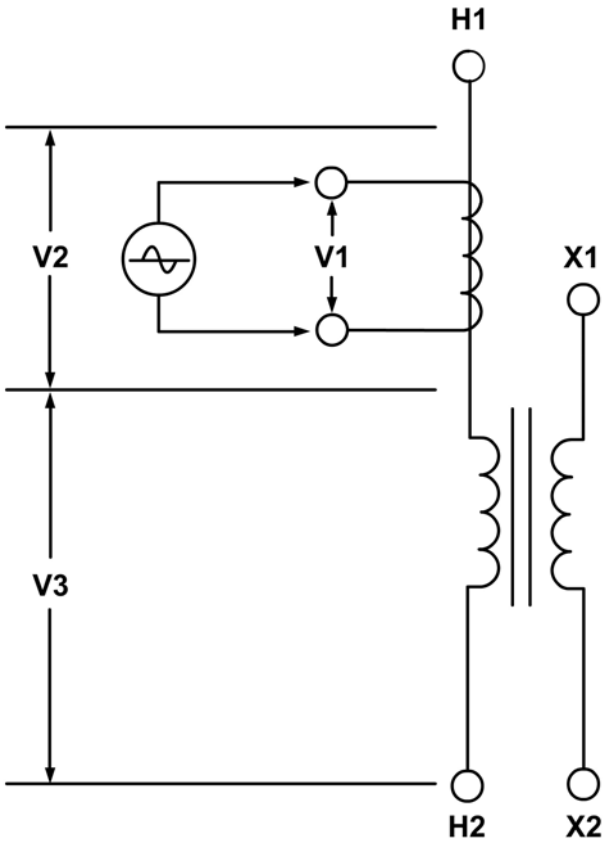


Figure 30

Ideally, we would like to eliminate the V3 voltage and only see the V2 voltage. If the induced V3 voltage on the transformer winding cannot be eliminated, the **turns-ratio measured will be wrong!**

Since this is a single phase transformer, and the transformer **secondary winding is accessible**, the user can apply a jumper to short out the transformer secondary winding as shown in Figure 31. By shorting out the transformer secondary winding, the user can eliminate most of the V3 voltage (V3=0V).

Now the turns-ratio will be:

$$\textbf{Ratio}=\frac{V1}{V2}$$

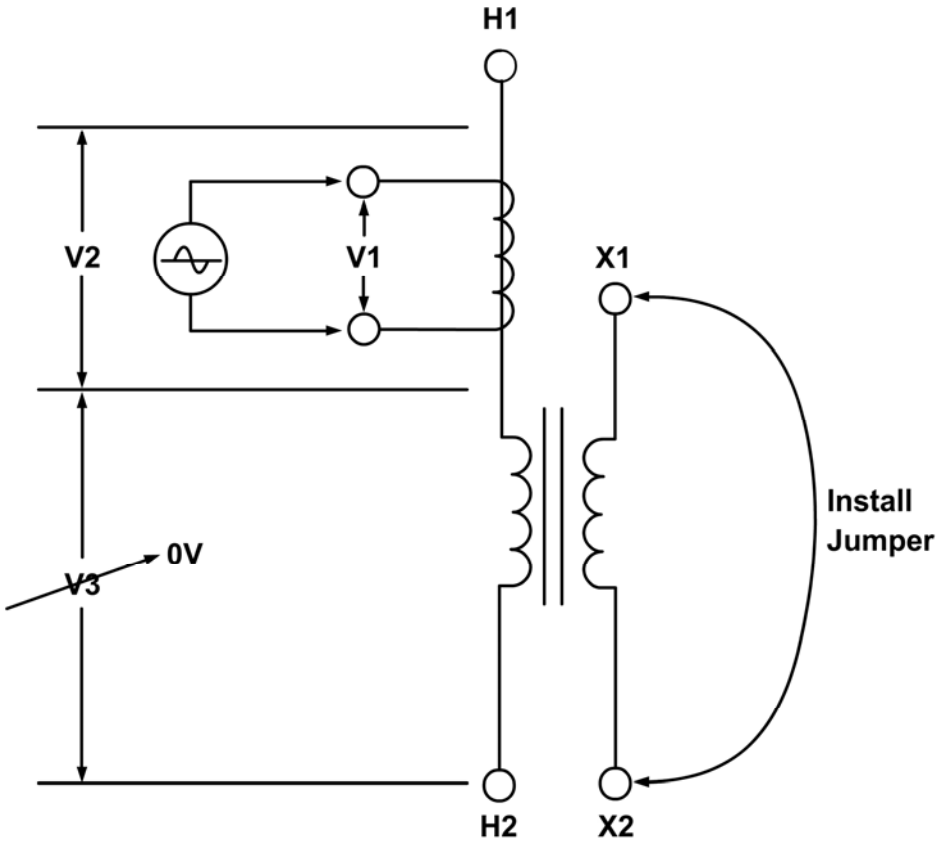


Figure 31

Figure 32 shows a **CT mounted on an auto-transformer**. This configuration is very similar to the CT mounted on a single phase transformer, the main difference being that the secondary winding is part of the primary winding.

The turns-ratio in this case will be:

$$\text{Ratio}=\frac{V1}{(V4)}=\frac{V1}{(V2+V3)}$$

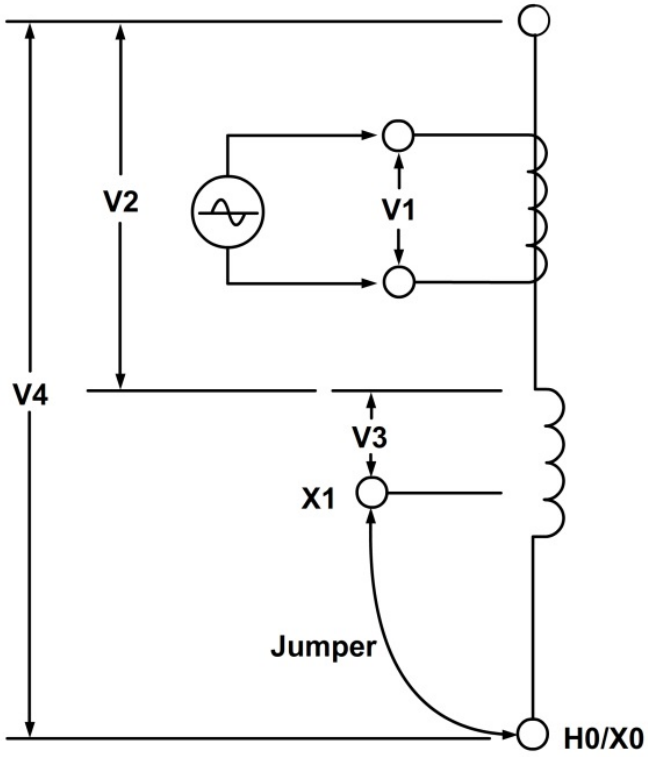


Figure 32

By shorting out the transformer's secondary winding (X1 to H0/X0); we can eliminate the voltage induced from X1 to H0/X0. The voltage V3 cannot be eliminated and will create an error in the CT turns ratio measurement. The amount of error depends on the amount of turns of the secondary windings. The alternative method to verify the CT turns ratio is shown in Figure 34 and Figure 35.

Figure 33 show a **CT mounted on a typical shunt reactor**. This configuration is very similar to the CT mounted on a single phase transformer, the main difference being the lack of the secondary winding! The turns-ratio in this case will be:

$$\text{Ratio}=\frac{V1}{(V2+V3)}$$

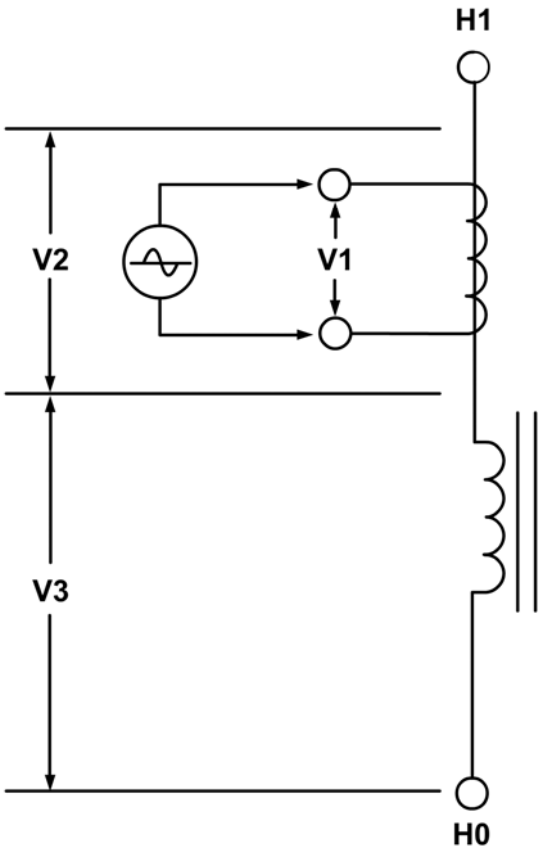


Figure 33

Since there is no secondary winding on the shunt reactor, the V3 voltage cannot be eliminated from the connection. The turns-ratio measurement from using this method will **always have some built-in error**. The amount of error depends on the size of the reactor winding and the number of turns on the CT's secondary winding. The alternative method to verify the CT turns ratio is shown in Figure 34 and Figure 35.

Figure 34 show a CT with 5 taps. The turns-ratio of the CT can be measured by treating the CT secondary winding as an auto-transformer. When using this method, the **effect of the shunt reactor winding is totally eliminated.**

The turns-ratio [(X1-X5)/(X2-X5)] measured by the EZCT or any electronic TTR will be as follows:

$$\textbf{Ratio} = \frac{V1}{V2}$$

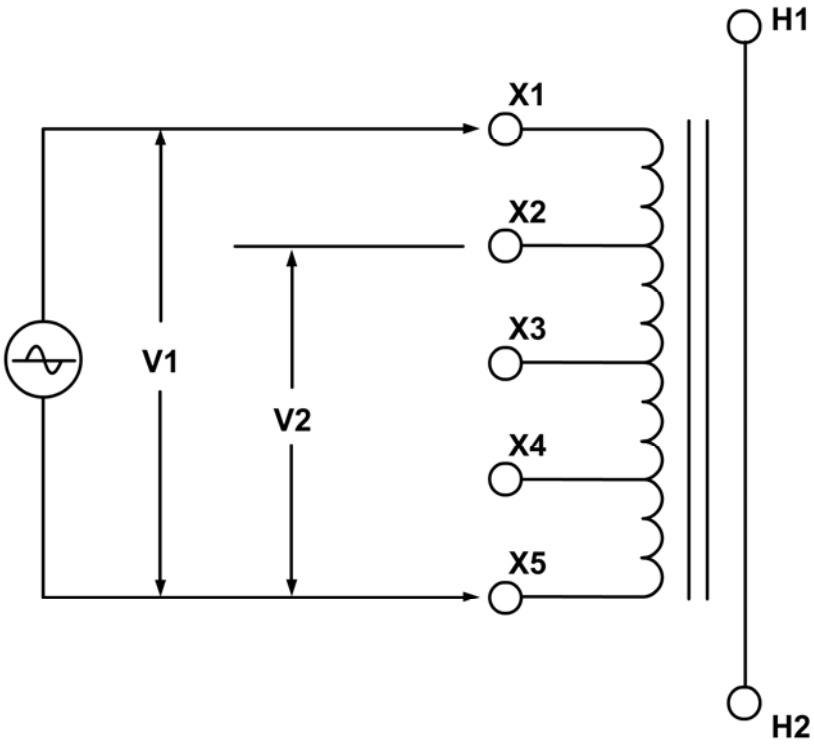


Figure 34

From the name plate of the CT show in table below, the turns-ration can be calculated as follows:

Ratio	Terminal
1200-5A	X1-X5
1000-5A	X2-X5

$$\text{Calculated Ratio} = \frac{Ratio\ (X1-X5)}{Ratio\ (X2-X5} = \frac{240}{200} = 1.20$$

A common practice for verifying the CT turns-ratio in the field is to apply an AC voltage to the CT secondary full winding (X1-X5). A volt meter can be used to verify the voltage drop across the CT terminals.

For example, if a 120Vac voltage is applied to the X1-X5 of this CT, the voltage reading across X2-X5 shall be expected as follows:

$$\frac{V(X1-X5)}{V(X2-X5)} = \frac{1200}{1000} = 1.2$$

$$\frac{120v}{V(X2-X5)} = 1.2$$

$$V\ (x2\text{-}x5) = 100V$$

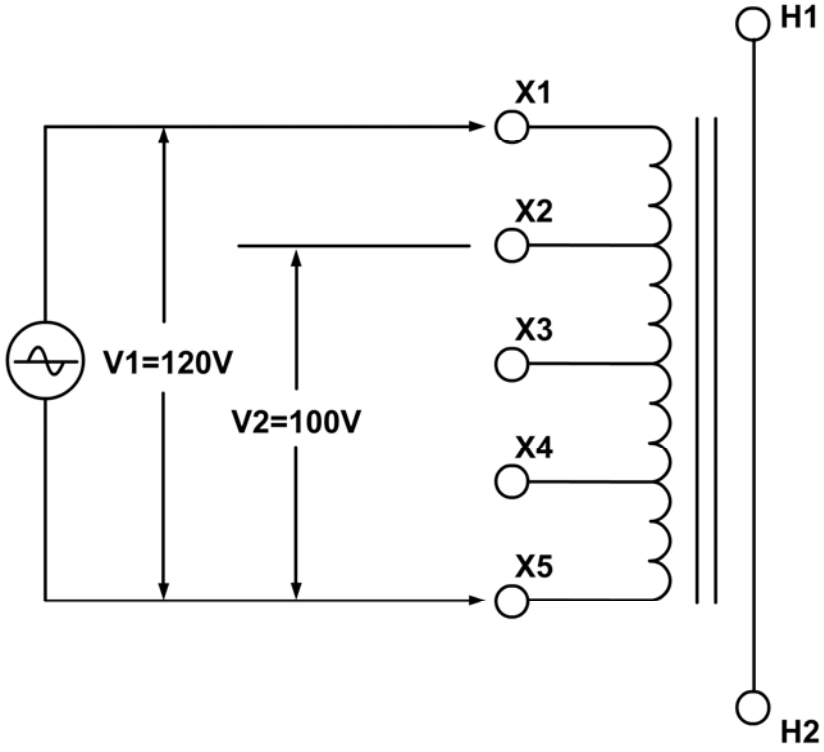
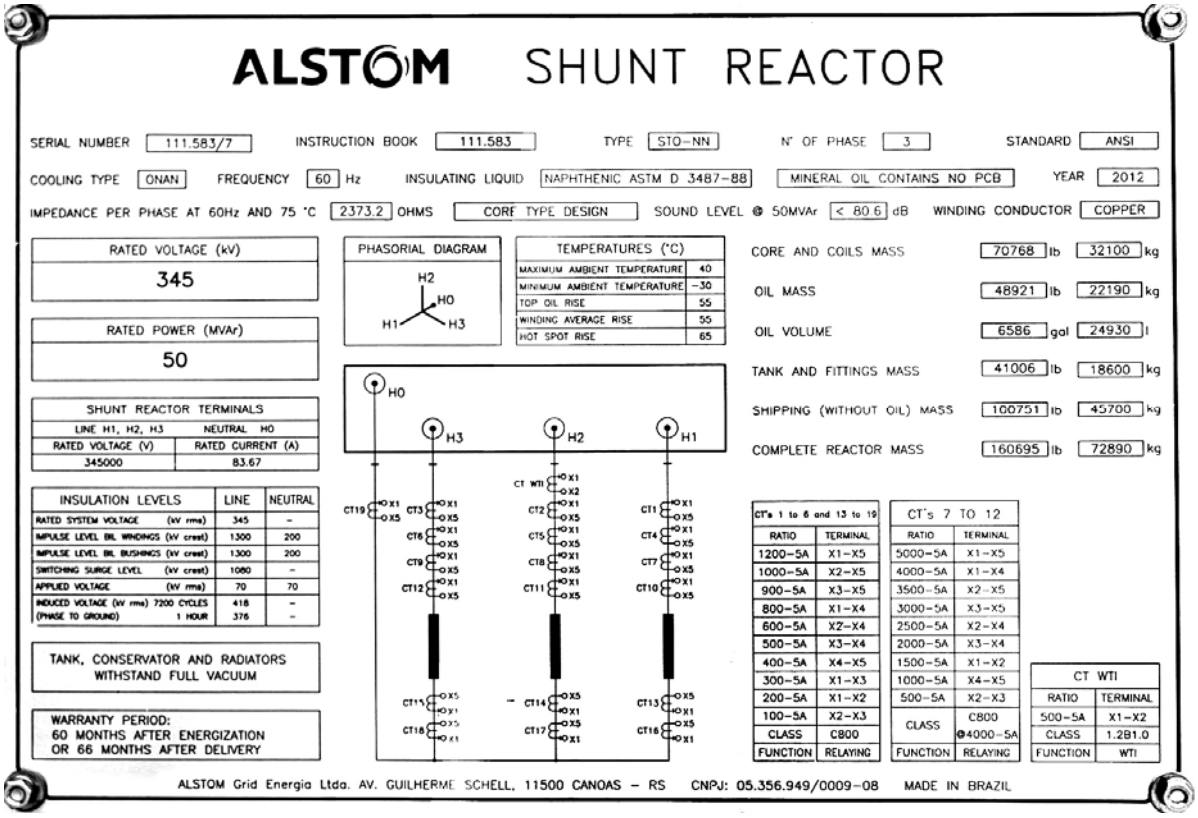


Figure 35

This method also eliminates the effect of the auto-transformer or reactor windings.



ALSTOM SHUNT REACTOR

SERIAL NUMBER 111.583/7 | INSTRUCTION BOOK 111.583 | TYPE STO-NN | N° OF PHASE 3 | STANDARD ANSI

COOLING TYPE ONAN | FREQUENCY 60 Hz | INSULATING LIQUID NAPHTHENIC ASTM D 3487-88 | MINERAL OIL CONTAINS NO PCB | YEAR 2012

IMPEDANCE PER PHASE AT 60Hz AND 75 °C 2373.2 OHMS | CORE TYPE DESIGN | SOUND LEVEL @ 50MVAr < 80.6 dB | WINDING CONDUCTOR COPPER

RATED VOLTAGE (kV)
345

RATED POWER (MVAr)
50

SHUNT REACTOR TERMINALS	
LINE H1, H2, H3	NEUTRAL H0
RATED VOLTAGE (V)	RATED CURRENT (A)
345000	83.67

INSULATION LEVELS		LINE	NEUTRAL
RATED SYSTEM VOLTAGE	(kV rms)	345	-
IMPULSE LEVEL BIL WINDINGS	(kV crest)	1300	200
IMPULSE LEVEL BIL BUSHINGS	(kV crest)	1300	200
SWITCHING SURGE LEVEL	(kV crest)	1050	-
APPLIED VOLTAGE	(kV rms)	70	70
INDUCED VOLTAGE (kV rms) 7200 CYCLES		418	-
(PHASE TO GROUND) 1 HOUR		376	-

TANK, CONSERVATOR AND RADIATORS WITHSTAND FULL VACUUM

WARRANTY PERIOD:
60 MONTHS AFTER ENERGIZATION
OR 66 MONTHS AFTER DELIVERY

PHASORIAL DIAGRAM

TEMPERATURES (°C)	
MAXIMUM AMBIENT TEMPERATURE	40
MINIMUM AMBIENT TEMPERATURE	-30
TOP OIL RISE	55
WINDING AVERAGE RISE	55
HOT SPOT RISE	65

CORE AND COILS MASS	70768	lb	32100	kg
OIL MASS	48921	lb	22190	kg
OIL VOLUME	6586	gal	24930	l
TANK AND FITTINGS MASS	41006	lb	18600	kg
SHIPPING (WITHOUT OIL) MASS	100751	lb	45700	kg
COMPLETE REACTOR MASS	160695	lb	72890	kg

CT's 1 to 6 and 13 to 19	
RATIO	TERMINAL
1200-5A	X1-X5
1000-5A	X2-X5
900-5A	X3-X5
800-5A	X1-X4
600-5A	X2-X4
500-5A	X3-X4
400-5A	X4-X5
300-5A	X1-X3
200-5A	X1-X2
100-5A	X2-X3
CLASS	C800
FUNCTION	RELAYING

CT's 7 TO 12	
RATIO	TERMINAL
5000-5A	X1-X5
4000-5A	X1-X4
3500-5A	X2-X5
3000-5A	X3-X5
2500-5A	X2-X4
2000-5A	X3-X4
1500-5A	X1-X2
1000-5A	X4-X5
500-5A	X2-X3
CLASS	C800 @4000-5A
FUNCTION	RELAYING

CT WTI	
RATIO	TERMINAL
500-5A	X1-X2
CLASS	1.2B1.0
FUNCTION	WTI

ALSTOM Grid Energia Ltda. AV. GUILHERME SCHELL, 11500 CANOAS – RS CNPJ: 05.356.949/0009-08 MADE IN BRAZIL

Figure 36

Figure 37

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